Women traditional coffee vendors harmful utilization of traditional biomass energy for cooking in Bahir Dar City: Ethiopia

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List of Acronyms and Abbreviation

CSA	Central Statistical Agency
EPRDF	Ethiopian People Revolutionary Democratic Front
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GHG	Greenhouse gas
HAP	Household Air Pollution
ICS	Improved Cookstove
IEA	International Energy Agency
LPG	Liquid Petroleum Gass
SDG	Sustainable Development goal
SPSS	Statistical Package for Social Science
SSA	Sub-Saharan Africa
WTCV	Women Traditional Coffee Vendor
UN	United Nations
WHO	World Health Organization

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Abstract

Biomass energy is an important but generally overlooked source of energy in many developing countries, and it is used in a highly inefficient manner, especially in households. This is due to the direct burning of wood, charcoal, leaves, agricultural residues, and animal dung for cooking. The majority of Ethiopian population is dependent on the use of traditional biomass energy. Their dependence is also related to socioeconomic situation and place of residence. Almost the entire population in rural areas of Ethiopia uses traditional biomass, while the urban population uses it as a supplementary. As for the target population of this study, traditional coffee vendors on the streets of Bahir Dar also use traditional biomass for coffee preparation. Therefore, the study investigated the factors that determine the traditional biomass energy consumption pattern, access, and the health impacts. The study is based on the theory of access and the model of energy lander and stacking. To achieve these objectives, a mixed methods research approach with concurrent research design was used. Data were analyzed both quantitatively (descriptive and inferential statistics) and qualitatively (thematic). The analysis revealed that biomass energy type, income level, and access to credit are positively related to biomass energy consumption patterns. That is, increasing access to other traditional biomass, increasing income, and access to credit led WTCV to use energy from multiple traditional biomasses. Age, on the other hand, is negatively related to women's energy use behavior, meaning that as women's age increases, they are more likely to use a single traditional biomass than multiple biomasses. Thus, based on the regression results, WTCV are more likely to use the energy stack model than the energy lander model. In addition to the determinant factors, both the descriptive and textual data showed that WTCV they are using because the ceremonies performed with traditional biomass are required by customers and has traditional values. As a result, the higher reliance on traditional biomass energy causes lung (breath) related health effects and bodily injuries from open fire use.

Key words: Biomass energy, Traditional biomass, Women traditional coffee vendors, Health effects, Energy access, Energy utilization, Bahir Dar, Ethiopia

Relevance to development studies

Access to healthy and sustainable energy for various purposes is hindered by different socioeconomic factors. For this reason, households in economically poor countries rely on traditional biomass energy, which has enormous health consequences, especially for women and children. Access to safe and healthy energy is one of the United Nations Sustainable Development Goals (7(1)), which states, "Ensure access to affordable, reliable, sustainable and modern energy for all." However, due to natural and human-made forest degradation and poor electrical infrastructure, women are forcing to collect firewood from distant areas. Furthermore, not only scarce access to biomass energy, but also traditional methods of use exacerbate health and environmental impacts. Thus, in this research context, the researcher tried to answer the research questions related to the determinant factor energy consumption pattern, access to energy and health impacts of traditional biomass energy on women traditional coffee vendors in Bahir Dar city, Ethiopia. It is hoped that this research will contribute to the achievement of sustainable development by investigating the problem and being used to design policy and program on health friendly biomass energy utilization in the study area.

Chapter one: Introduction

1.1 Nature of the study

Ethiopia's coffee brewing is different from others in many ways. The dining area undergoes several pre-ritual ceremonies before this event. First, all coffee cups and nibbles are placed on a table. Both the table and the floor are covered with freshly cut grass. Pleasant incense is burned to purify the room. The length of time take for the ceremony is depends on the events that the holiday ceremony is much longer than the daily personal ceremony. However, when it comes to the vendors, it lasts up to what they want to work. In Ethiopia, drinking coffee is an incomparable sensory experience. The women going to prepare coffee wear traditional cloth. The first preparation step is washing and roasting through Mitad (traditional name for iron pan). After the coffee beans are roasted the women brough to the visitor to inhale and smell. This is an important part of the sensory experience of Ethiopian coffee.

In the same coffee ceremony, many women work in the street preparing coffee in the traditional way. As an Ethiopian, I was one of the customers of the traditional coffee sellers. This allowed me to observe how they work and what kind of energy they use in their business. My personal experience led me to ask questions about their energy consumption. Even though it is common to use charcoal as an energy source in traditional coffee preparation, other types of traditional biomasses are also used. Due to varieties of factors, the health impact is expected to be more severe on the Vendors than those private users. It is not secret that unemployment is the reason why many women become traditional coffee vendors in Ethiopia. Their economic level does not allow to find enough energy for making coffee. In addition to the scarcity of energy, the place where they work, and season has effect of the efficiency of energy. Observing all these challenges motivated me to investigate the harmful use of traditional biomass energy for coffee preparation by women traditional coffee vendors in Bahir Dar City, Ethiopia.

1.2 Contextual background

Even though biomass energy is used in most developing countries, is important and overlooked energy sources. 14% of the world's population uses biomass, which is used primarily in households in highly inefficient ways. Due to the use of inefficient cookstove a significant amount of biomass energy is lost. The overuse of biomass creates another related problem: indoor pollution and unnecessary greenhouse gas (GHG) emissions (Adamu, 2009, p.87). Traditional biomass is the poorest energy source (IEA, 2002a, cited in Karekezi et al., 2004, p.2), i.e., direct combustion of wood, charcoal, leaves, agricultural residues, and animal dung for cooking and lighting (EPRDF, 2013, p.13). As a result, developing countries are using biomass as the main sources of energy, mainly in Africa. However, biomass also used in efficient way called Modern biomass fuels (MBFS)**, it is** produced by converting biomass into liquid and gaseous fuels, including ethanol, biogas, and production gas. Stoves for modern biomass fuels are carefully designed and built and easy to operate. Modern biomass fuels have a high conversion efficiency of 30-40%. MBFs promote a clean cooking environment by significantly reducing indoor pollutant and greenhouse gas emissions (Karekezi et al. (2004, p.2).

About 2.6 billion people who lack access to clean cooking (58%) live in rural areas, but they are more evenly distributed among the three largest access-deficit regions-Central and South Asia (31%), Sub-Saharan Africa (35%), and East and Southeast Asia (29%)-than is the case for access to electricity. Sub-Saharan Africa is by far the worst affected area, with around 85% of people, more than 80% of rural dwellers, and over 70% of urban dwellers lacking access to clean cooking facilities (International Energy Agency, et al., ,2021, p. 58). Total annual consumption of wood by urban households (including charcoal equivalent) is estimated at 11.2 million tons, of which 1.3 million tons is charcoal. The total consumption of manure is 0.4 million tons per year and of residues 2.1 million tons (Geissler et al., 2013).

Access to energy in Ethiopia is closely linked to socioeconomic issues. According to the EPRDF (2013), energy is one of the most important factors for Ethiopia's economic growth and social development. The energy sector in Ethiopia can be divided into two categories: traditional and modern (traditional use of biomass and modern fuels such as electricity and petroleum). From the total population of Ethiopia 80% of them are living in rural areas and engaged in smallholder farmers are using traditional biomass. Regarding this, EPRDF added that in some places access to biomass fuels has been severely reduced throughout the country. The reduced availability of woody biomass has

significant implications for development and society. 92% of Ethiopians rely on biomass for energy. This is the reason why the majority of Ethiopians dependent on biomass energy in the world. This energy is mainly used for baking and cooking in the household. As a result, the amount of energy consumed in the household is much larger than that used for other purposes (ibid, p.17).

Even if low-income levels prevent households from consuming efficient energy, failure to adapt to the demands of economic growth also has a negative impact. In this regard, Kahsai et al. (2012) found that inadequate energy services affect the realization of development aspirations of SSA states. In addition, growing populations in urban and rural areas, as well as strong economic growth and rising wages in some SSA countries, have put additional strain on the region's already strained energy supply (p.739). Although traditional biomass use can be reduced through urbanization and increase per capital income and increase to use modern energy (IEA, 2009, p.225). Rather it is prevalent that families are going to use multiple sources of energy that shifting to the other when income increase. A thorough understanding of families' fuel choice behaviors will help in formulating appropriate policies and initiatives aimed at alleviating energy poverty and reducing environmental and health risks (Alem et al.,2013, p.3). According to Heltberg (2005) and Mekonnen and Kohlin (2008), household income is an important factor, although not the only one. Modern fuels are often used alongside traditional solid fuels, especially in rural areas and among a significant proportion of urban populations in developing countries.

The urban population growth rate of Ethiopia is 4.8% in which the population in 2050 is expected to be 205 million (The World Bank, 2021). Ethiopia has set a target to become a low middle income country by 2025 (National Planning Commission, 2016, p.76), which would require annual GDP growth rates of 8-10% between 2015 and 2030 (Planning and Development Commission, 2021). Long-term population and economic dynamics are required to achieve energy demand and supply projections. Ethiopia's total annual bioenergy resources are projected to be at 153.4 million tons. Of this, woody biomass accounts for 73% (wood 69% and charcoal 4%), while animal dung (14% and residues 13%) are second and third (Tiruye et al.,2021, p.10). Due to their poor socioeconomic status, traditional coffee vendors in Ethiopia, especially in Bahir Dar city, are victims of inefficient and incorrect use of biomass energy, and their consumption patterns are affected by a variety of variables.

1.3 Statement of the problem

All traditional users of biomass resources are from impoverished developing countries. In developing countries, energy use poses significant environmental and health risks to rural and disadvantaged urban families. The lack of clean and affordable energy is considered a major barrier to development (Idiata et al., 2013). Current global energy policies are attempting to shift away from the use of expensive and polluting fossil fuels to more cost-effective energy from renewable resources (health-friendly modern biomass, wind, water, and solar). Due to socio-cultural and economic problems, there is a mismatch between energy demandand supply in Ethiopia (Guta, 2012).

According to Beyene et al. (2018), most Ethiopian households cook with polluting fuels and technologies, with the figure approaching 100% in rural areas (p.14). The heavy reliance of the country's bioenergy sector on traditional biomass energy has serious implications for the country's economic, social, and environmental sustainability. Even though biomass is considered sustainable, its direct combustion for cooking is unsafe and contributes significantly to greenhouse gas emissions if not properly managed (Ministry of Water and Energy, 2012). The reason why the majority of Ethiopians use biomass is due to lack of access, high poverty, technological backwardness, and various other problems. The Ethiopian economy has relied too much on traditional biomass to meet national energy needs, which has led to various problems. Hydropower and petroleum products account for most of the remaining 1% and 7%, respectively. This shows how much the country's national energy balance depends on biomass resources (Guta, 2012, p.134).

Traditional biomass use is also inextricably linked to poverty. Households in emerging economies tend to switch to LPG fuel and other types of specialized electric cooking equipment as incomes rise. Thus, an obvious solution to the difficulties of biomass energy consumption in developing countries is wealth development. The use of efficient energy and improved cookstoves is related to the income level of the household or individual (Tessema & Mekonnen, 2021, p. 10). Despite doubling the average income level in a country, the number of people relying on biomass energy for cooking would only decrease by 16%, meaning that the use of biomass fuels in developing country households will continue for many years (IEA 2009). Although rural women have had limited access to energy, urban women face similar challenges: Income levels prevent the urban poor from switching from traditional fuels (such as kerosene, biomass, etc.) to modern electricity (Kebede et al, 2002 and Beyene, 2011).

Although urban families in Ethiopia use less harmful fuels and technologies, they still rely mainly on traditional biomass: 38% firewood and 30% charcoal. Clean fuels and technologies are used in about a quarter of households in large cities, with about 23% cooking with electricity and 1% with liquefied petroleum gas (LPG). In virtually every urban family, charcoal is used daily for cooking and coffee ceremonies. It is also commonly used for heating in urban homes, especially during the rainy season (Beyene et al.,2018, p.14). Improper use of biomass energy affects not only women but also children. For example, malnutrition, using charcoal for cooking, carrying a child on their back while cooking, and living in a crowded house were all risk factors for pneumonia in children under the age of five, defined as coughing, rapid breathing, and/or dangerous signs such as a pull in the chest and stridor (Fekadu et al., 2014).

In Ethiopia, several studies have been conducted on the utilization of traditional biomass energy and its socioeconomic and health impacts on women at the household level, but as far as my knowledge is concerned, no study has been conducted on women traditional coffee vendors (WTCV) and their use of traditional biomass energy. As mentioned earlier, this type of vendor is an emerging informal business. Given the novelty of the case and the seriousness of the problem among women traditional coffee vendors, the researcher has attempted to fill the knowledge gap by examining the harmful use of biomass energy for cooking in general, traditional biomass energy access, and the determinants of traditional biomass energy consumption patterns in Bahir Dar City in particular: Ethiopia. Therefore, based on the general objective, the following research questions were developed to address the problem.

1. What are the determinant factors for traditional biomass energy consumption patterns of women traditional coffee vendors?
2. How do women traditional coffee vendors access traditional biomass energy for making coffee?
3. What are the effects of traditional biomass energy utilization on the health of women traditional coffee vendors?

1.4 Relevance and justification

The purpose of this study is to investigate women traditional coffee vendors' harmful use of traditional biomass in making coffee. This research found important to those individuals, institutions, and organizations that have an interest in taking practical action on women's health and socioeconomic issues. In addition, Investigating the problem will help in the development of intervention strategies to improve their access to energy and methods of use. It will also serve as a base line for other researchers to examine and investigate problems on related issues. My justification for conducting this research is to investigate the traditional biomass use of women traditional coffee vendors to find out the real problem. Since the number of vendors is alarmingly increasing in a short period of time, it means that the number of traditional coffee sellers using traditional biomass energy is also increasing. Therefore, this study is found important to investigate the determinant factors of traditional energy consumption pattern, traditional energy access and health impacts of women traditional coffee vendors. The reason I chose this area as a case study is, first, because of the centrality in the regional state, numbers of unemployed women prefer to immigrate from rural to urban areas for looking job. However, some of them could not find other job and they joined to work as traditional coffee vendor in the streets of the city. Secondly, I knew the place well. Because I had been living in Bahir Dar for two years. And I was constantly a customer of these vendors. All these experiences helped me to observe their work situation regarding the use of traditional biomass for coffee preparation.

1.5 limitations of the study

Since the study was cross-sectional in terms of time, the lack of time to find out more information over time was one of the problems of this work. However, the researcher tried to use human power and other resources considering the time. In addition, even though the researcher managed to find out as much as possible, it was difficult to find enough literature for discussion due to the uniqueness of the study. As mentioned elsewhere, the target population of this study, WTCV, has not been researched in terms of biomass energy use. As a result, there is limited literature on the outdoor health effects of traditional biomass.

Chapter two: Theoretical and analytical framework

2.1 Introduction

This study draws on access theory to examine access to and use of traditional biomass energy among women traditional coffee vendors and its association with health outcomes. It also relies on the energy ladder model and the energy stack model to examine the factors that determine biomass energy consumption choices.

2.2 Theory of access

"Access" depends on a variety of characteristics, including constellations of methods, relationships, and procedures that, in combination with a "bundle of rights," enable multiple actors to derive benefits from resources (Mutea et al., 2020, p.2). Furthermore, Ribot & Peluso relate access to capability: *"access as the ability to benefit from things, including material objects, persons, institutions, and symbols" (Ribot & Peluso, 2003, p. 153).* In terms of access and control over resources, *"... focus on the issues of who does (and who does not) get to use what, in what ways, and when (that is, in what circumstances)" (Neale 1998:48 quoted in ibid., p.154).* In some cases, different individuals and institutions have varying degrees of access to and decision-making power over resources. Some individuals control resources, while others only have access (Ribot & Peluso, 2003, p. 154).

According to the United Nations Sustainable Development Goal 7(1), universal access to cheap, efficient, and modern energy services is both a necessity and a driver for improving the lives and working conditions of people worldwide. Many other SDGs are hindered by lack of access to modern energy, especially for the poorest and most vulnerable populations. Access to modern energy helps people escape poverty and increases their wealth, health, security, well-being, education and entrepreneurship; it also promotes gender equality and social, economic and political fairness (UN,2021, p.16). Similarly, Miller et al. (1991) also mentioned why some benefit from others, as different political and economic situations alter the conditions of access and thus the specific individuals or groups that can best benefit from a set of resources.

Energy access and health are inextricably linked, as timely and health-friendly energy promotes health, while poor (conventional biomass) energy is detrimental to the user's health. Lee et al. (2017) show that electrification has the potential to promote health in low- and middle-income countries in multiple

ways. Electric lighting and cooking appliances, for example, are thought to minimize indoor air pollution and respiratory illness by reducing demand for wood, charcoal, and kerosene (p.13). Similarly, improved access to media through television, radio, and the Internet (i.e., through the use of electricity) can also provide health information to influence health behaviors (ibid.), while access to electricity in health care facilities enables the use of essential medical equipment and improved sanitation and safety (Irwin et al., 2020). More specifically, according to Barron and Torero (2017), access to sustainable energy helps improve respiratory health and reduce infant and maternal mortality. However, the increasing use of traditional energy resources has negative consequences for environmental quality and human health. In particular, the burning of fossil fuels (WHO, 2015) accounts for 60% of greenhouse gas emissions generated by the energy sector (UNDP, 2019).

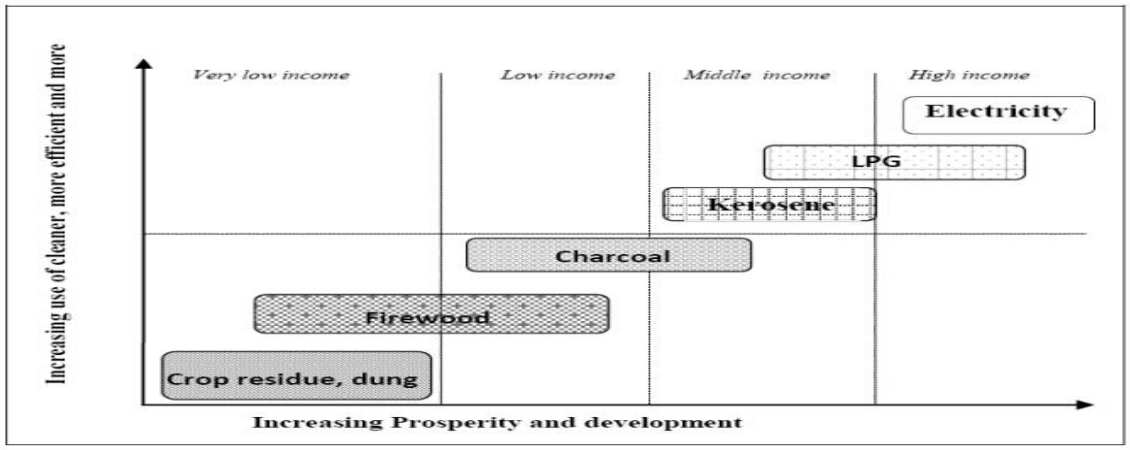
When we come to the application of the theory, Mutea et al., 2020 conducted a study entitled "*Applying the theory of access to food security among smallholder family farmers around North-West Mount Kenya."* The researchers used this theory to examine the respective bundles of rights and power that affect food security. Their research showed that food insecurity is not only the result of private property rights, but also access to agricultural technologies (Mutea et al., 2020, p.1). Based on the concept of the intimate relationship and its applicability to other related areas of research, I found the theory of access is most appropriate as a foundation for this research. For example, when women do not have efficient access to energy, they are forced to use biomass energy inefficiently and harmfully.

2.3. Energy ladder and stacking model

The concept of the energy ladder addresses differences in energy use behavior among families of different economic classes. According to the neoclassical consumer, households gradually switch to more sophisticated energy sources as income rises. In contrast to the poor, who use wood and crop waste, wealthier households use electricity and petroleum products (Hosier and Dowd, 1987, pp.347-348). The basic assumption is that households have a variety of energy supply options that can be ranked in ascending order of technical complexity. Electricity is at the top of the list, while firewood, manure, and crop waste are at the bottom. Assuming that the household's economic situation improves, it will move up the energy ladder and use more sophisticated energy sources. If the household's economic situation deteriorates, whether due to a loss of income or an increase in fuel prices, the household is more likely to "go down" the energy ladder and use less complex energy sources. Consequently, the energy ladder is a simplified extension of economic consumption theory:

as income increases (decreases), families not only buy more (less) of the same goods, but also migrate to higher (lower) value items (ibid.). Based on the energy ladder model, Leach (1992) and Barnes and Floor (1999) described the shift to a different fuel in three stages. The first stage is characterized by a complete dependence on the use of traditional biomass energy. Second, families are expected to switch to "transitional fuels" such as kerosene, coal, and charcoal in response to rising incomes, urbanization, and biomass scarcity. Finally, households are switching to liquefied petroleum gas (LPG), natural gas, or electricity for cooking.

Figure 1: Energy ladder model



Sources: WHO (2006) cited in Ado and Darazo (2016, p.87): An Empirical Analysis of Households Energy Choice in Ghana.

Several scholars have studied the energy consumption habits of the different socioeconomic categories of society. According to Bajracharya (1983, p.1058), energy consumption patterns in a Nepali village vary according to the socioeconomic condition of the household. Similarly, Kennes et al. (1984, p. 217) find that energy consumption patterns in Bangladesh vary widely by socioeconomic group. Families with formal occupations rely far more on commercial fuels than do landless or smallholder households. In the Indian city of Hyderabad, Alam et al. (1985) observed that household choice of fuel was directly related to income level. As income increased, households tended to prefer petroleum-based commercial fuels over biomass fuels.

Briscoe (1979) found that rural families in Bangladesh were climbing the energy ladder. In contrast, the switch of disadvantaged households to less sophisticated energy sources or purchased fuels is particularly evident. According to Hosier (1985), the decision maker in a rural Kenyan family must make a two-stage energy decision. In the first stage, he or she decides which fuels to use. In the second stage, he or she must decide how much of each fuel to use. In each case, the household's unique resource endowment determines the choices available to himor her - the better the family's economic situation or the more integrated the household is in the cash economy, the more options are available. In this research case, then, the energy ladder model fits to see how traditional coffee sellers switch from one biomass energy type to another depending on whether their income increases or decreases.

In contrast to the energy ladder model, the energy stack model assumes that family behavior in choosing an energy source and the transition process, especially in developing countries, do not necessarily follow a unidirectional, straight-line movement from one energy source to another. This model assumes that families vary their energy portfolio and use "different fuels" regardless of changes in income levels, rather than switching completely from traditional biomass energy to modern fuels (Masera et al., 2000, p. 2095). The fundamental reason households use "multiple fuels" is to save energy and benefit from the complementarities between traditional and modern fuels (Kebede et al., 2002; Nansaior et al., 2011). The energy stacking model views household energy transition as a protracted process resulting from the complex interplay of economic, technological, and social elements, rather than a single-income, unilateral fuel switch (Masera et al., 2000, p.2092).

Research has shown that households in most developing countries continue to use different types of energy without switching to another, despite switching from one type of energy to another (Pachauri and Spreng, 2004; Elias and Victor, 2005; Ouedraogo, 2006). For example, the empirical study by Masera et al. (2000) used longitudinal data to examine the behavior of families in the village of Jaracuaro and in several Mexican states that use multiple energy sources. Similarly, a study by Mekonnen and Kohlin (2009) titled: *"Determinants of household fuel choice in major cities in Ethiopia"* was also conducted. The researchers concluded that households in Ethiopian metropolitan areas tend to increase the number of fuels they use as their income increases, rather than switching completely from traditional fuels (such as wood) to modern fuels (such as kerosene and electricity). For a variety of reasons, including preferences, tastes, security of supply, cost, cooking and consumption habits, and the availability of technology, households tend to shift to a strategy of multiple fuel use (fuel stacking)

as income increases. (p. 17). In addition to a variety of reason mentioned by Mekonnen and Kohlin (2009), household size is one which shape energy consumption patter. According to Gamtsessa (2003, p.15), household consumption patterns and energy demand in metropolitan areas indicate that the small impact of traditional fuel costs suggests that extraordinarily large changes in consumption patterns are to be expected. Household size is related to all forms of energy use. However, this relationship is stronger for old fuels than for modern fuels. This indicates that households with a large family rely more heavily on conventional fuels than those with a small family.

Although the energy ladder model and the energy stacking model have different conceptions of household energy consumption patterns, both are important concepts for this study. Thus, the researcher is not determined to use one of the two models before examining whether they switch from one type of traditional biomass energy to another or adopt multiple fuel consumption strategies rather following what will be the finding of the research after analysis.

2.4. Conclusion

Access to traditional biomass energy by women who traditionally sell coffee is framed by the theory of access as a lens that shows that their lack or sufficiency of access is or is not determinative. Although there are other factors, access to biomass energy is also critical. Women's access to energy varies according to their economic capacity and social capital. In line with the access theory, the energy ladder model and the energy staking model are also important to know whether they shift or multiply. Thus, access and other critical factors contribute to the traditional biomass energy consumption behavior of female vendors. To decide on which model influences WTCV consumption behavior, the researcher proposes to test the energy ladder model and the staking model.

Chapter three: literature review

3.1. Introduction

This chapter discusses the literature on traditional biomass use and its health implications. To be clear, the literature begins at the level of Africa and specifically addresses Ethiopian conditions. In developing countries like Ethiopia, most households use traditional biomass energy for cooking and other purposes. The chapter addresses access to traditional biomass energy and the health implications for women. This is because the traditional gender division of labor forces women to perform reproductive work such as cooking food. As a result, there is a strong link between women's labor and the health impacts of traditional biomass.

3.2. Biomass energy for cooking

The most important ingredient for all human activities is energy. How we spend our time depends greatly on the type and amount of energy resources available to us. The search for an adequate energy supply is inextricably linked to the larger issue of human life and progress. This dilemma is most obvious and severe in the Horn of Africa, where a lack of energy infrastructure creates enormous obstacles to social and economic progress. More than three-quarters of the population in these countries lack access to modern fuels or electricity, millions of women and children work long hours to collect fuel, and the urban poor pay a significant percentage of their income to meet their basic daily energy needs. Thus, Ethiopia's average energy consumption is among the lowest in the world, with biomass accounting for more than 90% of total national energy consumption in its various forms (Mulugetta, 2007, p.3).

Energy from biomass can be renewed because it is derived from living things. The only known ecologically acceptable and renewable source of energy that can be derived from a variety of sources and used to replace fossil fuels is biomass. All aquatic and terrestrial species, plants and trees, virgin biomass and dead biomass, and wastes such as municipal solid waste, sewage sludge, animal wastes (manure) and residues, forestry and agricultural residues, and other forms of industrial wastes can be included (Klass, 2004). Traditional biomass is used directly for cooking, water heating, and other purposes in developing countries without additional processing.

The importance of energy in the history of human civilization cannot be overstated. Cooking energy has long been necessary for family well-being and was part of what distinguished prehistoric humans from animals (Heltberg, 2003). Scientific studies addressing the increasing reliance of humans on biomass as an energy source for cooking, such as firewood, agricultural waste, charcoal, and animal dung, have sparked debate and continued to come to the forefront (International Energy Agency et al., 2006). As a result, the choice of energy source for domestic use remains critical and an issue that is constantly on the agenda in both qualitative and quantitative terms (Amoah, 2019, p.103). The qualitative agenda can be its relationship with traditional way of consumption whereas its accessibility in quantity.

In most cases, it is the women in impoverished countries who provide food for their families. Ethiopia is an excellent example of how women manage a wide range of activities in both rural and urban areas. They are responsible for production, reproduction, and community management. Women's responsibility for food preparation is closely linked to social reproduction. Unable to purchase efficient energy, women resorted to less efficient biomass. Bhattacharya and Salam (2002) found that the amount of fuel consumed in a cooking system was inversely related to the efficiency of the system. In addition, emission variables are greatly influenced by numerous elements involved in the combustion process, such as the type of fuel, methods of use and design, operating conditions, etc. (p.313). Thus, switching to a lower status of the type of energy results in the health of women and children being affected due to the inefficiency use.

People's preferences for using modern energy for cooking and improved cookstoves are determined by various factors, the most important being the economic level and accessibility of energy (Ouedraogo, 2006.p.3787). For example, Fawehinmi and Oyerinde (2002) in a descriptive study conducted in Nigeria found that the high price of modern energy has worsened the level of poverty. As a result, the use of biomass energy remains the first choice for households. In line with this, Sow (1990), cited in Ouedraogo (2006.p.3787) stated that, most sub-Saharan African countries rely on the use of wood energy for cooking and that many people also cannot find enough energy to cook a meal. Access to biomass fuel is now a day became scarce because of uncontrolled forest deformation for different purposes including for cooking. On the other hand, access to sustainable and clean energy provides several opportunities through cooking methods that maintain women's health, improve livelihoods, and empower women while protecting the environment (Marchand et al., 2019).

3.3. Biomass energy utilization in Africa

Biomass energy remains an important source of household energy, especially in developing countries where it is cheap and readily available. Wood-based fuels are the predominant energy source for about 94% of Africa's rural population and 73% of its urban population. The urban population prefers charcoal, while the rural population prefers firewood (International Energy Agency, 2014). In Kenya and Tanzania, for example, there is growing concern about the severe environmental and social consequences of this dependence on wood-based energy.

The main arguments against the continued use of wood-based energy are pressure on forests, loss of soil and water quality, greenhouse gas emissions, and negative impacts on human health due to indoor air pollution (Okoko, 2017, p. 125). According to the International Energy Agency (2014) and Hall (1991) uses a specific example to show that while biomass energy is used primarily in rural areas of developing countries, it is also an important source of fuel for the urban poor and many small and medium enterprises in rural areas. Consequently, we need to be concerned about the equity of the poor, especially women, who play an important role in the provision and use of biomass energy through their cooking activities (p.711).

To meet Africa's growing energy needs, woody biomass is expected to become a major domestic energy source. About half of the world's population, including 81% of sub-Saharan Africa (SSA), uses energy from woody biomass for cooking, residential, and commercial purposes. This figure is significantly higher than in other regions of the world. Even if woody biomass use increases in China, India, and many other developing countries, this will not be enough to meet the needs of sub-Saharan Africa, which are expected to continue to grow in the coming decades (World Bank, 2011; Eleri and Eleri, 2009). In contrast, Africa's dependence on biomass energy varies. In poor African countries, biomass, particularly woody biomass, accounts for a significant share of total energy.

3.4. Biomass energy in Ethiopia

Renewable energy is usually defined as energy derived from resources that are naturally renewed within a given period. In this decade, the three emerging renewable energy sources are wind, solar, and biomass (Tadele et al., 2013; Berhanu etal., 2017). Traditional biomass fuels cover about 89.6% of the total energy consumption in Ethiopia, while modern energy sources account for only 10.4% (Gebreegziabher and Mekonnen, 2011; Tadele et al., 2014). Biomass is mostly obtained from adjacent forest resources and agricultural wastes such as firewood, charcoal, cow dung, and crop wastes (CSA ,2011). However, in large cities, most users buy biomass from the market supplied by rural residents or traders. Poor women-headed households, however, are unable to buy charcoal and must instead collect it from farmers' plots or from the forest.

More than 95 % of rural households in Ethiopia cook with firewood, agricultural residues such as leaves and cow dung (Tucho and Nonhebel, 2015, p.9566). Not only being dependent but also it is insignificant, and utility sectors are a clear indication of the country's energy poverty. Scarcity of energy at the level of the needs of the population is the major obstacle for rural socio-economic development (Wolde-Ghiorgis, 2002, p.1096). Even though the rural population is affected from scarcity of energy, the urban populations too are dependent on biomass, specifically poor women. Rural economies are the driving force behind the country's development, but their dependence on a sluggish energy supply system reportedly threatens land and labor productivity (Negash and Riera, 2014). Since the distribution of improved cookstoves in rural areas is minimal or nonexistent, most biomass is used as fuel in conventional cookstoves. The most common traditional stove used for cooking in rural and disadvantaged urban families, the three-stone open fire, has a conversion efficiency of only about 12% (Mengistu et al., 2015, p.311).

Energy from biomass is considered a public good. The forest provides biomass fuel to 93% of rural households and 7% of urban families. In rural areas, most of the energy from solid biomass (charcoal, firewood, dung, and agricultural waste) is used for cooking (Kebede, 2004). The traditional use of biomass energy is not only inefficient, but also potentially harmful to health. According to Dercon and Krishnan (2000) and Zerbo (2017), indoor air pollution is responsible for 3.82% to 6.62% of the disease burden in sub-Saharan Africa, making it the leading cause of mortality after hunger, HIV/AIDS, water shortage, and poor sanitation. Ethiopia poses the highest health risk due to its dependence on traditional biomass.

Even when urban households are connected to the electricity grid and can use it for cooking, charcoal and firewood remain the main sources of energy for daily cooking (Tucho et al.,2014, p.426). Although the infrastructure is in place, the services are not sufficient to meet the needs of the metropolitan population. In addition to infrastructural inadequacies, disadvantaged urban residents do not benefit as much as other economically savvy communities. For example, female-headed families, especially traditional coffee vendors, mainly use biomass for coffee making and domestic use. In this context, Gazull et al. (2019) found that low-income urban families who cannot afford electricity and its associated amenities continue to rely on biomass energy for cooking (p.1080).

3.5. Health effects of traditional biomass energy utilization

People in Ethiopia, both urban and rural, rely heavily on traditional biomass fuels such as wood, dung, leaves, twigs, charcoal, and other. Burning biomass releases carbon monoxide, hydrocarbons, and particulate matter into the atmosphere. The health of the fireplace is also affected by smoke from combustion (Geremew et al., 2014, p.2). According to Mazzoni and Isaac (2003), the health effects of biomass energy are determined by two parameters: first, the number of pollutants that vary throughout the day depending on the use (combustion or smoldering), type of stove and fuel, and the effectiveness of a ventilation system or chimney. Second, the time you spend in a contaminated environment (p.2). Considering these two parameters, impoverished households not only rely more heavily on biomass, but also use inferior cooking equipment and live in poorly ventilated homes, exacerbating the negative health impacts of incomplete combustion and poor smoke dissipation. WHO (2007) stated that, the most important clues have always been the type of fuel used and people's involvement in preparing meals. Indoor air pollution is much worse in areas where the average household income is less than $1 per day. In more specific, UNEP (2007) showed that indoor air pollution from biomass uses causes about 36% of lower respiratory infections and 22% of chronic respiratory diseases.

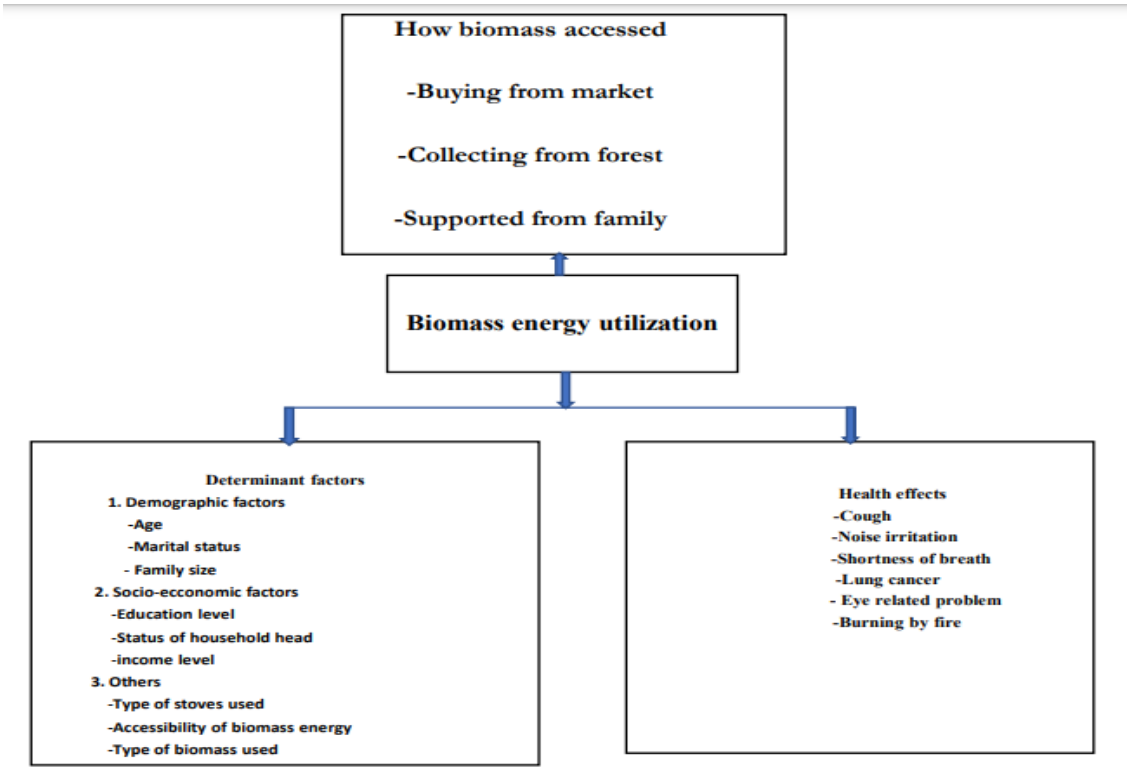
There are several disadvantages to using biomass. The International Energy Agency (IEA) claims that resources are collected in an unsustainable manner and that energy conversion technologies are inefficient. As a result, human health, the environment, and socioeconomic growth suffer. Cooking and heating with solid fuels releases significant amounts of hazardous pollutants such as particulate matter and carbon monoxide, which according to Duflo et al. (2008) are among the sources of local and regional air pollution that can cause illness and death. The use of solid fuels for cooking, heating, and lighting in the home is a major source of indoor air pollution (p. 2). According to UNDP and

WHO (2009), indoor air pollution from biomass cooking kills about 2 million people worldwide each year from pneumonia, chronic lung disease, and lung cancer, with poor countries accounting for 99% of these deaths. According to the organizations, women account for 60% of adult mortality in poor countries, including less developed countries and sub-Saharan Africa. After 9 years, WHO (2018) reported that about 4 million people died prematurely from diseases caused by domestic air pollution due to improper cooking habits, including polluting stoves and solid fuels.

3.6. Conceptual framework of the study

A conceptual framework for this study was based on the literature review. The quantitative focus is on socio-demographic parameters (age, household size, education level and status of household head), income level, type of stoves used, access to traditional biomass energy and type of traditional biomass used. Another focus is on health effects (cough, noise irritation, shortness of breath, and lung cancer). The qualitative part focuses on how traditional coffee traders obtain traditional biomass energy.

Figure 2. Figurative relation among access, determinant factors and health effects in traditional biomass utilization



3.7. Conclusion

Due to the low social and economic development of the continent, African households are the main users of traditional biomass energy. The extent of use in rural areas is much greater than in urban areas. However, the urban poor also use biomass as a supplement or sometimes independently. In the case of Ethiopia, the poorest part of urban society uses electricity only for lighting. Thus, the severity of traditional biomass health impacts depends on the accessibility and the time spent using it. The literature therefore examines how access to traditional biomass energy is related to health and what factors determine energy use patterns.

Chapter Four: Research methodology

4.1. Introduction

This chapter discusses the research methods that fit the nature of the study question. Mixed-methods research approach is used, considering both the quantitative and qualitative nature of the study. Based on these two approaches, the researcher selected the samples from the population using probability and non-probability sampling. The quantitative data collected were analyzed through simple descriptive and inferential statistics, while the data collected through interviews and focus group discussions were analyzed through thematic analysis. The trustworthiness of the research is also ensured through reliability and validity for the quantitative data, as well as credibility, transferability, confirmability, and dependability for qualitative part. Finally, ethical issues are considered throughout the research process.

4.2. Description of the study area

The study area of this study is in the city of Bahir Dar, one of the largest cities in Ethiopia. It is in the center of the Amhara National Regional State and borders the southern part of Lake Tana. The urban area of Bahir Dar covers a radius of 25 kilometers around the city center. Bahir Dar city is in the heart of the metropolitan region. Its exact coordinates are 11o37' north latitude and 37o25' east longitude. The distance from Addis Ababa is 550 km by road via Bure and 460 km via Motta, while the flight time is 55 minutes. The urban area lies between 1650 and 2100 meters above sea level. The average altitude of Bahir Dar ranges from 1786 meters above sea level (near the seacoast) to 1886 meters above sea level(https://en.wikipedia.org/wiki/BahirDar,2017).

4.3. Research approach

The philosophical worldview of this research is pragmatism. Pragmatism is not committed to one of the systems of philosophy, rather, the assumption draws from both qualitative and quantitative approaches (Creswell, J.W. and Creswell, J.D, 2017, p.10). So, to compensate for the shortcomings of each approach and to capitalize on their strengths, I the research depend on both qualitative and quantitative approach. Qualitative data is typically open-ended, whereas quantitative data is closed-ended (ibid., 14). Drawing from pragmatism world view, mixed method design was used. From the mixed methods designs, I found the convergent research methods preferred to my research that all qualitative and quantitative data collections gone side by side and integrated at the level of interpretation. Using the two approaches in single research has two advantages, *"One to gain an in-depth perspective and the other to generalize to a population" (ibid, p.219).* Thus, the research relied on these basic ideas to deeply investigate the problem.

4.4. Sampling and sample size determination

4.4.1. Quantitative sampling

The researcher used probability sampling technique. *"Probability sampling means that every item in the population has an equal chance of being included in sample"* (Taherdoost, 2016, p.20). Thus, with this sampling technique, women traditional coffee vendors survey has an equal chance to be a sample. The sampling is free of personal bias because the researcher selects only what the technique allows. So, the researcher used the Cochran (1963, p.75) formula that is important to determine the number of samples from the larger population, which is representative sample for the proportion.

$$\text{no} = \frac{Z^2 Pq}{e^2}$$

Where, no= Numbers of samples required

z =the value of the desired confidence level or confidence interval (95%=1.96)

e = the desired level of margin of error or precision

p=estimated variability or proportion of an attribute in the population (50%=0.5)

q =1-p

Consequently, when examining the expected criterion, the researcher used a 95% confidence level (z=1.96), the highest population variability (50%), and a margin of error/precision of 5%.

So based on the formula: $\frac{(1.96)^2(0.5(1-0.5)}{(0.06)^2} = \frac{3.8416*0.5*0.50}{0.0036}$ =266.77 = **267**

For the selection of 267 samples, the city was stratified into six sub-cities (Dagemawi Menilik, Tana, Fasilo, Gishe Abay, Belay Zeleke and Atse Tewodros). And then 267 samples are divided into each sub-city (267/6=45). Finally, the individual samples selected by systematic sampling from the main streets of each sub-city. The sample selection starts from one side of the street and is made based on the given interval. Note: The population size in each street is estimated. Tana (Gudo Bahir Street, 80 TCV, through 2 intervals), Belay Zeleke (Belay Zeleke Street, 120 TCV, through 3 intervals), Atse Tewodros (Beg Tera Street, 87 TCV, through 2 intervals), Gish Abay (Cherka Ckerk street, 95 TCV, through 2 intervals), Fasilo (Aba Fasio Street, 115 TCV, through 3 intervals and Dagemawi Menilik (Mulualm street, 150 TCV, through 3 intervals).

4.4.2. Qualitative sampling

The participants selected using a non-probability sampling. The samples do not have an equal chance of being included in the research. Instead, those individuals who the researcher believes provide relevant information were selected. Thus, a purposive sample is drawn from the non-probability sampling to select participants based on the criteria. Accordingly, those who have been working as traditional coffee vendor for more than one month were selected. This criterion also applied to the focus group discussion. And to obtain clearer and more depth data, the researcher tried to select samples for discussion from those who were interviewed individually. However, the number of participants and discussants are not predetermined rather based on the data saturation.

4.5. Data sources and types

Both primary and secondary sources were used for this research. Primary sources for collecting primary data include survey respondents, interviewees, and participants in focus group discussions. On the other hand, secondary sources such as books, journals, and annual reports related to the study were used to obtain secondary data. In relation to secondary data, Kothari (2004) suggested that someone else collects and analyzes or written sources allows for the interpretation or registration of primary data.

4.6. Data collection instruments

Questionnaire, interview and FGD were the data collection tools used to collect primary data (see below).

Survey questionnaire: Quantitative data were collected by the researcher using organized questions/questionnaires, which saved time and money. According to Roopa and Rani (2012), a questionnaire is used when resources are limited because it is very inexpensive to create and administer and because time is an important resource that is maximized through a questionnaire. It also protects respondents' privacy because they will only answer honestly if their identity is hidden, and confidentiality is maintained (p.273). The questionnaire contains both closed and open-ended questions that were used to prepare and collect primary data from respondents. The questionnaire was designed to collect information on the variables that drive traditional coffee vendors to use biomass energy and its health effects.

Since the respondents spoke Amharic, the questionnaire was written in English and translated into Amharic. A pretest was conducted to detect design and instrument errors and to collect alternative data from sample respondents. Efforts were also made to ensure that all respondents had the same background for the questions in the surveys and to find out how long it takes on average to administer an instrument. As a result, a pilot test was conducted with 10 randomly selected respondents from the research region to establish validity, avoid confusing or ambiguous questions, and make the responses understandable. All this helped to collect useful data and refine the questions.

Interview: The researcher divided the interview into two categories: Individual Interview and Focus Group Interview. Creswell (2014) explained that the researcher will conduct in-person interviews with participants, telephone interviews, or focus group interviews with six to eight respondents at a time. The interview will consist of unstructured, open-ended questions (p.190). The individual and group interviews (discussions) were conducted in the Amharic language, as this is the medium of communication for the interviewees and discussants in the field, with an active assistant who took notes and received appropriate instructions to coordinate the protocols. The researcher acted primarily as a moderator during the discussions. All discussants had equal opportunity to contribute their ideas. After each interview, the notes were summarized, and important and relevant points were noted to help the researcher reformulate the interview question. During the interview, audio recordings were

made using a tape recorder and notes were taken depending on the interest of the participants. The researcher felt that recording the interview was of utmost importance to capture all the information. Eight interview was mad with a minimum of 35 minutes and a maximum of 1:30 minutes and Two FGDs with eight members were also interviewed, which lasted 1:30 hours each.

4.7. Data analysis techniques

Both quantitative and qualitative data analysis methods were used in this study, and it was found that a combination of data analysis methods is essential for this research. In quantitative data analysis, empirical and numerical data are tabulated, analyzed, and summarized to characterize or generalize the population based on samples. Consequently, descriptive, and inferential statistics are used to analyze quantitative data. According to Loeb et al. (2017), descriptive analysis is used in almost every empirical article and report, whether to identify and characterize trends and variations in populations, develop new measures of significant phenomena, or simply describe samples in research aimed at discovering causal effects (p.2). After data collection was completed, data were coded, revised, and entered into SPSS (Statistical Package for Social Science) version 23 and then analyzed using descriptive and inferential statistics. The sociodemographic background of the respondents and the health effects of biomass energy use were examined using descriptive quantitative analysis.

A binary logistic regression model was used to examine the factors that determine biomass energy consumption behavior because it is a powerful statistical tool that allows us to determine the effects of independent variables on the dependent variable while holding any number of other independent variables constant. In this context, binary logistic regression is a type of regression used when the dependent variable is dichotomous, or a dummy variable and the independent variables are of any type (Dattalo, 2008). The variables collected in the questionnaire were continuous and categorical, and the variables used in the analysis are categorical because the results of binary logistic regression require a test of association or the chi-square test. Therefore, the chi-square test was used to examine the relationship between independent variables such as age, marital status, family size, education level, household status, income level, work experience, access to traditional biomass energy, type of energy used, type of stove used, and access to loan with energy consumption pattern.

The researcher used thematic data analysis for qualitative data. The main goal of the analysis is to identify themes from the data collected. The analysis is more inductive in that the categories into which the themes are placed are not determined before the data are coded. While the general themes were determined prior to the analysis, the specific categories, and themes to be explored were not determined in advance. The data collected were explained in detail in the guiding and probing questions about access to energy among traditional coffee vendors. Data collected through interviews and FDG were transcribed in Amharic and then translated into English. Following the transcription, the data were coded. In this phase, the pre-coded stories, statements, and ideas were transformed into meaningful codes during the interview and FDG. This was the phase of translation into English. During translation and coding, the researcher worked with the back-and-forth technique to ensure that participants' meanings and intentions were considered. In the categorization phase, the coded data were classified into similar, related categories. This categorization shows how the different codes were constructed into similar categories of different types that lead to a meaningful form. According to Tucket (2005), categorization of data helps to divide texts into meaningful groups that make the data manageable. Finally, the main themes were developed based on the categorization. The categories were divided into main themes and subthemes to meet the specific objectives of the study.

4.8. Reliability and validity issues for the quantitative

Reliability refers to the consistency, stability, and repeatability of results; that is, a researcher's result is considered reliable if consistent results have been obtained in identical situations but under different circumstances (Twycross and Shields, 2004). Similarly, validity is the extent to which a measurement instrument measures what it is intended to measure (Thatcher, 2010). Therefore, before conducting the actual study, the researcher conducted a pretest with 10-15 respondents to ensure the reliability of the questionnaire. This helped to avoid ambiguity in the questions and to determine the level of understanding of the respondents.

The researcher analyzed multiple sources of information and developed a chain of evidence to confirm the validity of the study. Essentially, a duplicate questionnaire set was used to assess the idea or construct of interest (content validity). The experts expect to make some useful suggestions to modify the structured questionnaires and discussion guides to make them more targeted and reduce some unnecessary content. In addition, the researcher triangulated between the data sources and the detailed descriptions to convey the results and complement the statistical findings with the qualitative part of

the study. The findings and results of the study were interpreted in light of the literature review and previous research to allow for analytical generalization. Thus, the use of mixed methods improves the validity and robustness of the conclusions of this study by complementing the statistical data.

4.9. The model goodness of fit (GOF)

The goodness of fit (GOF) of a statistical model indicates how well it fits a set of observations. GOF indices characterize the difference between observed and predicted values based on a statistical model. GOF statistics are indices with known sampling distributions used in statistical hypothesis testing (Maydeu-Olivares and Garcia-Forero, 2010, p.190). Thus, before starting the analysis, the goodness of fit was checked using the Omnibus test and Hosmer and lemeshow. To determine the goodness of fit, the result of the Omnibus test should be significant at a p-value of less than 0.05. In contrast to the omnibus test, the result of the Hosmer and Lemshow test should have a p-value greater than 0.05.

4.10. Trustworthiness for qualitative section

In this study, the trustworthiness of the research was also tested by credibility, transferability, confirmability, and reliability. First, credibility refers to the qualitative researcher's belief in the validity of the research study's findings. It all boils down to the question, "How do you know your results are real and accurate?" The researcher used triangulation to establish the credibility of the study. Second, the researcher demonstrated transferability by showing that the results of the research study could be applied to other situations. They could relate to similar conditions, populations, and events. Qualitative researchers can use detailed descriptions to show that the results of the research study are relevant to different places, events, and scenarios. Third, the degree of neutrality of the research study's conclusions is referred to as confirmability. In other words, the conclusions are based on the participants' responses and not on any possible bias or personal goals of the researcher. This means ensuring that the researcher's bias did not influence the study participants' responses. To demonstrate confirmability, the researcher presented an audit trail illustrating each phase of the data analysis conducted to provide an explanation for the judgments made. In this way, it can be demonstrated that the conclusions of the research study adequately reflect the responses of the participants. Finally, the extent to which the study could be replicated by other researchers and the results would be consistent is referred to as reliability. In other words: If someone wants to repeat this study, they should be able to do so using the information in the research report and get equivalent results.

4.11. Ethical considerations

Participants in this study were first informed of the purpose and nature of the research and asked for their consent to participate in the study. Clear reference was made to anonymity; the information obtained will be kept confidential and anonymous wording was used when necessary. The information collected from the participants will be accessible only to the researcher. The participation of the respondents was decided based on their decision. Most importantly, the researcher interviewed based on the consent of the participants. To increase the respondents' confidence to express their ideas freely, suitable places and times were selected according to their suggestions. Even though the respondents gave their consent, they were free to withdraw at any time (during) the interview. Finally, the researcher informed the participants/respondents that the results of the research will be shared with them according to their interest and desire.

4.12. Conclusion

The research methodology of the study is developed based on the objectives of the study. Accordingly, the philosophy of pragmatism is applied with mixed methods to investigate the research problem. Due to the given time, the cross-sectional research design was used in terms of time. So, the researcher prefers to use the concurrent research design because the data must be collected at a given time and analyzed independently and integrated at the discussion level. The relevant and trustworthy primary and secondary data were collected considering the objectives and purpose of the research and analyzed using quantitative and qualitative techniques. Hence, to gain the trust of the reader of the study, ethical aspects were considered, and trustworthiness was ensured by using rational and complementary research methods to answer the research questions.

Chapter Five: Results and Discussion

5.1. Introduction

The chapter deals with the analysis, discussion and interpretation of the data collected through questionnaire, interview, and focus group discussion. It consists of two parts: quantitative and qualitative. The quantitative part focused on describing the socio-demographic characteristics of the respondents and the health effects of using traditional biomass through percentages and frequencies and the inferential statistics were used to analyze and interpret the determinants of energy consumption behavior of traditional coffee vendors with binary logistic regression through the chi-square value to determine the relationship between dependent and independent variables. While the qualitative section focuses on access to energy, some of the quantitative questions are also discussed to explore in more detail. These include the relationship between stove type, family size with energy consumption patterns and health impacts.

Part I: Quantitative result and discussion

5.2. Socio-demographic characteristics of the respondents

Based on the ascending order in terms of their percentage 82% (18-28), 33% (28-38), 12% (below 18) and only 3% above 38. As can be seen from the data in Table 5.1, most of the traditional coffee sellers working in this informal business are young, i.e., between 18 and 28 years old. On the other hand, we can also see that the age group above that is less numerous. Thus, the data implied that women aged 18-28 years are affected by high unemployment and consume biomass for making coffee.

Regarding the marital status of the respondents, 55.6% (single), 36.5% (married), 7.5% (divorced) and 0.4% (widowed). Although the age group of most respondents is between 18 and 28 years old, the majority (55.6%) of them are single. However, 36.5% of them are married, so their livelihood depends on making coffee on the street. Matching the marital status of the respondents, the family size is 62% (2-5), 33.8% (1) and 4.1% (above 6) in decreasing order. So, these data show that respondents live with their family or rent a house with another partner to cope with the difficulties of living in the city.

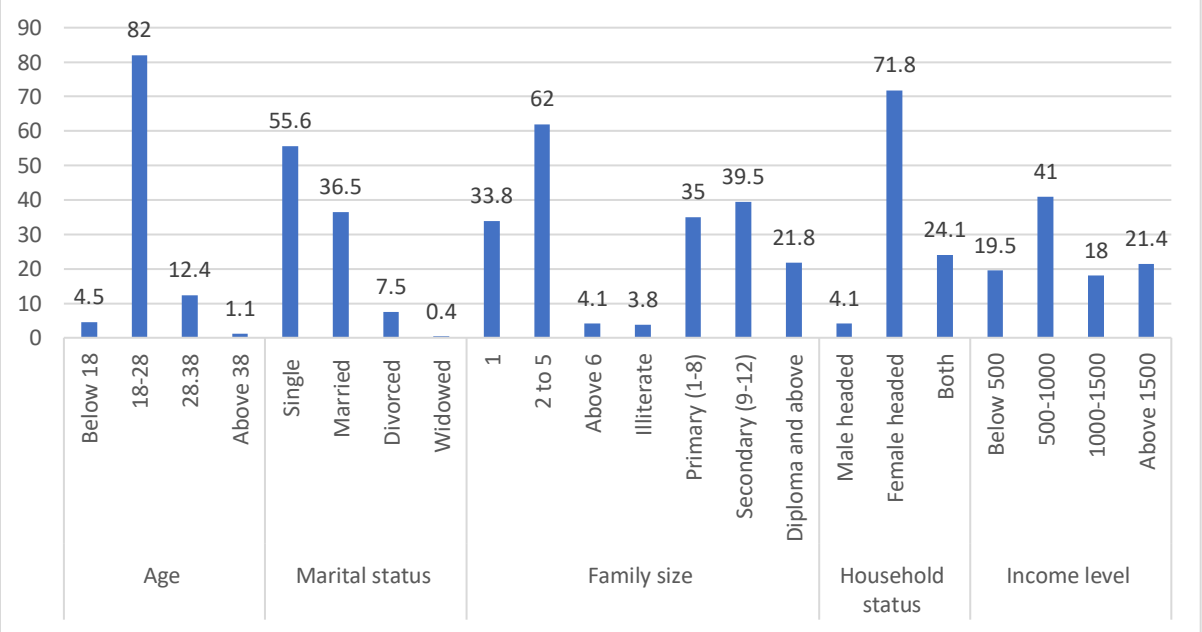
The education level of respondents is another variable that provides insight into who is highly involved in traditional coffee preparation on the streets of Bahir Dar City. From the analysis, 39.5% (secondary (9-12), 35% (primary (1-8), 21.8% (diploma and above) and 3.8% (illiterate). From this, we can infer

how many of them are educated in the business of directly using traditional biomass energy to make coffee. Thus, the majority (39.5%) have at least a high school and only 3.8% of respondents are illiterate.

The household status of the respondents is described as 71.8% (female head of household) and 4.1% (male head of household), while 24.1% have both a male and a female head of household. It is clear from the data that respondents are most likely to live alone or with their female partner. This is closely related to the marital status of the respondents, most of whom are not married. The reason why women are living as female headed has a positive effect: the more women are single or unmarried, the more they live in female headed household than male headed households.

The monthly income of the respondents is 41% (500-1000), 21.4% (above 1500), 19.5% (below 500) and 18% (1000-1500). Thus, the majority of the 41% are in the 500-15000 income category, which means that their income level is also reflected in their biomass energy consumption. However, the income of the respondents is also below 500 (19.5%), which means that the income from making traditional coffee on the street in Bahir Dar does not exceed this range.

Figure 3 Socio-Demographic characteristics of the respondents



Source: Own survey data, 2022

5.3. Determinant factors on biomass energy utilization patterns of WTCV

The binary logistic regression model was used to determine the relationships between women's biomass energy consumption patterns and numbers of explanatory variables. Binary logistic regression has become the preferred tool in the social sciences for predicting dichotomous outcomes, because it is more flexible than any other model. Therefore, a binary logistic regression model was used to determine the relationship between the dependent variable (biomass energy use patterns of women) and the independent variables (socio-demographic, type of stove, access to loan and access to energy) that influence women's traditional biomass energy use as traditional coffee vendors. For this test, the researcher selected 12 explanatory variables. However, only 4 independent variables (age, income level, type of biomass use, and access to loan) were found to explain the dependent variables.

The omnibus test model coefficient at the chi-square of $X^2(25, 266)$, 129.110, $p < 0.005$ is significant at p=0.000. This means that the selected predictor variables have a combined effect in predicting the biomass energy consumption patterns of women traditional coffee vendors (Appendix iii). In addition to the omnibus test of the model, Hosmer and Lemshow also showed that the chi-square value was significant at $X^2(8, 266)$, 14.009, $p > 0.005$ with p=0.082, indicating that it has goodness of fit. In addition, the summary of the model showed that the model summary demonstrated that (pseudo R^2=0.514), which means that the outcome variable is 51.4% explained by the independent variables.

When we get to the "variables in the equation," i.e., how the independent variables affect the outcome variable, it showed that women traditional coffee vendors with the ages of 18-27 decreased to use multiple biomass energy than the under-18 age group, with an odds ratio of 0.62. That is, holding the other independent variables constant, WTCV are less likely to use multiple traditional biomass energy sources, and there is a negative relationship with biomass energy use pattern at $p < 0.05$, P=0.033. Even though the p-value is not significant, when we see the effects of age variable, the odds ratio is 28-38 (0.188) and above 38(0.332). This means when the age increases the probability to use multiple biomass decrease, the vise versa is true. When the age decreases, WTCV probability to use multiple type of biomass energy is increase.

The analysis result of the income level of women in the category of 500-100, 1000-1500 and above 1500 have higher probability of using energy from multiple biomasses than women with income below 500, at the odds ratio is 16.319, 45.364 and 56.786, respectively. The binary regression result shows that women's probability of using multiple biomass energy increases when the income level of traditional coffee vendors increases, statistically significant at $p > 0.05$, $p=0.000$ for all income categories. In this regard, Masera et al. (2000) studied in several Mexican states that women use multiple energy sources when their income increases. Similarly, Mekonnen and Kohlin (2009) concluded in a local study that households, in major Ethiopian cities, tend to increase the number of fuels they use as their income improves rather than moving away from traditional fuels completely (p.17).

The result of the binary logistic regression shows that women who use firewood have a higher and positive probability compared to who do not. Based on the binary logistic regression result, the probability of using multiple biomass energy of women traditional coffee is 60.272 more likely to use multiple biomasses than those who do not use firewood as statistically significant at $p > 0.05$, $p=0.000$. Similarly, women who use municipal waste have a positive association with using energy from multiple biomasses than those who do not use it for coffee preparation, with an odds ratio of 9.698 at a statistically significant p-value of > 0.05, $p=0.013$. Research by Beyene et al. (2018) showed that urban families in Ethiopia, while using less harmful fuels and technologies, still rely mainly on biomass: 38% firewood and 30% charcoal (p.14). This research implied that despite the use of other types of biomass energy, firewood and charcoal are used primarily in urban areas. Similarly, women who traditionally sell coffee predominantly use charcoal and other types of biomasses such as firewood. Thus, the result of the binary regression on the type of biomass energy use is directly related to the findings of Beyene et al. (2018) in large cities in Ethiopia.

Binary logistic regression showed that women who have access to credit are more likely to consume multiple biomass energies. The probability of women having access to credit increases by the odds ratio of 4.506 compared to those who answered "No" at a statistically significant value of $p < 0.05$, $p=0.001$. Thus, women who have access to loan has a positive relation with using multiple biomass energy use. The results of the analysis indicate that access to credit has a statistically significant relationship with biomass energy consumption behavior among women traditional coffee vendors.

5.1 Table: Determinant variables on biomass energy utilization patterns of WTCV

Variables	Categories	B	df	Sig.	Exp(B)
Age	Below 18 **(RC**)		3	.200	
	18-27	-1.817	3	.033	.162
	28-37	-1.691	1	.093	.184
	Above 38	-1.104	1	.641	.332
Marital Status	Unmarried (**RC)**		3	.257	
	Married	-.547	3	.218	.579
	Divorced	.809	1	.282	2.246
	Widowed	-20.136	1	1.000	.000
Family size	1 (**RC)**		2	.607	
	2-5	.391	2	.377	1.479
	Above 6	-.195	1	.854	.823
Level of education	Illiterate (**RC**)		3	.087	
	Primary (1-8)	-.510	3	.673	.601
	High school (9-12)	.340	1	.778	1.404
	Diploma and above	.034	1	.978	1.035
Household status	Male headed (**RC**)	-.129	2	.876	.879
	Female headed	.808	1	.328	2.244
	Both		1		
Level of income	Below 500 (**RC**)		2	0.92	
	500-1000	2.792	3	.000	16.319
	1000-1500	3.815	1	.000	45.364
	Above 1500	4.039	1	.000	56.786
Working experiences	Below 6 months (**RC)**		2	.368	
	6 months -1 year	.384	2	.346	1.468
	Above one year	.238	1	.580	1.269
Type of biomass (FW)	No (**RC)**				
	Yes	4.099	1	.000	60.272
Type of biomass (Cha)	No (**RC**)				
	Yes	-23.673	1	1.000	.000
Type of biomass (MR)	No (**RC**)				
	Yes	2.272	1	.013	9.698
Access to biomass	No (**RC)**				
	Yes	1.538	1	.173	4.655
Type of stove use	Traditional (**RC**)				
	Improved	.096	3	.976	1.101
Access to lean	No (**RC**)				
	Yes	1.505	1	.001	4.506
Saving account	No (**RC**)				
	Yes	-.291	3	.437	.747
	Constant	19.735	1	1.000	3723696 66.869

Source: Obtained from survey data, 2022

Note: RC refers to reference category

5.4. Health effects of using biomass energy on WTCV

This section focuses on the health of traditional biomass effects with considering the sociodemographic characteristics. It is better to think of how much of WTCV in different categories are affected by the improper use of biomass energy. According to the demographic characteristics, the number of WTCV is high in the age group of 18-28 (82%), single marital status (55.5%), secondary education (39.5%), female head of household (71.8%) and income level of 500-1000 (41%). However, others also have some contribution to the health effects of traditional biomass. This is because it shows a vivid picture of the magnitude of health impacts in the different categories.

5.4.1 Respiratory related health effects

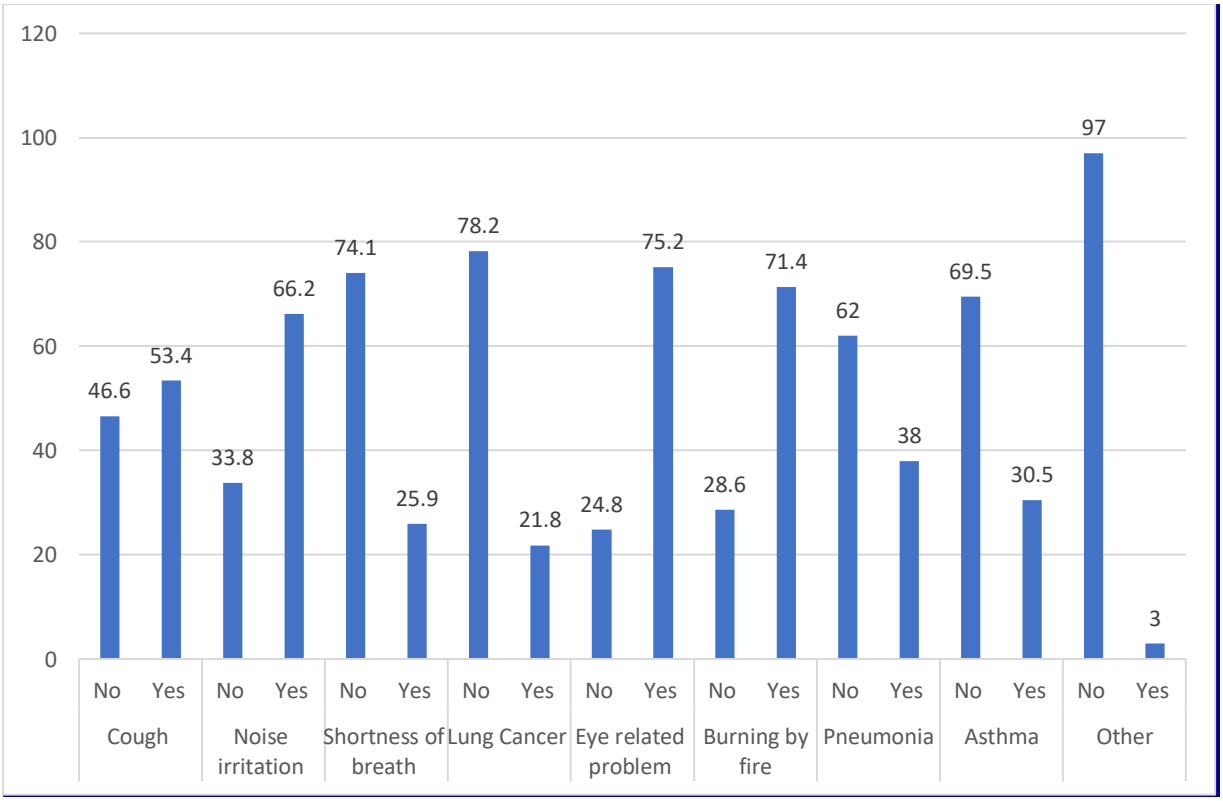
Respiratory health problems are directly related to lung or breathing. Direct combustion of biomass in traditional coffee preparation causes health problems. Based on the descriptive analysis, 53.4% (142) of the respondents responded that they are affected by cough, while about 44.6% (124) they do not affect. Thus, the majority of women traditional coffee vendors are victims of smoke from traditional biomass energy. In terms of noise irritation 66.2% (176) are affected but only 33.8% (90) of them are not affected. Like coughing caused by biomass, the majority are affected by the nose irritation. The breathing capacity of women is also affected by biomass through shortness of breath, but the majority, 74.1% (197) of women, are not affected, while only 25.9 (69) of them are affected. Similarly, pneumonia (62%), and asthma (69.5%) are affected while 38%, and 30.5% are not, respectively but 78.2% of them do not get lung cancer while 21.1 of them get.

Research has shown that it causes air pollution from carbon monoxide, hydrocarbons, and particulate matter. Smoke from combustion also affects the health of the fireplace (Geremew et al., 2014, p.2). The IEA (2007) also added that resources are collected in unsustainable ways and energy conversion technologies are inefficient. As a result, this has negative impacts on people's health (p.12). According to UNDP and WHO (2009), approximately 2 million people worldwide die each year from pneumonia, chronic lung disease, and lung cancer, with 99% of these deaths occurring in developing countries (5). It is mentioned somewhere that vendors working hours with biomass also increase the level of the health effects.

5.4.2 Physical related health effects

The use of biomass energy also has physical implications. Even when women use a locally made improved cookstove, they are victims of charcoal fire. The statistical descriptive analysis shows that the majority of coffee sellers (71.4%) suffered burns, while only 28.6% of women did not. Since they are in business, they are exposed to open fire when they try to make fire. Another major problem is the eyes: 75.2% of the respondents have this problem, while 24.8% do not. This is because they use their breath to fire charcoal. And the analysis showed that the majority responded that they do not have other health problems (97%), while only 3% of them were affected by it.

Figure 4. Percentage distribution of the health effects of utilizing traditional biomass energy on WTCV



Source: Own survey data, 2022

Part II: Qualitative result and discussion

5.5 Traditional values of traditional biomass energy utilization

As clearly explained in the study, these vendors are making coffee in a traditional way. As it was the Ethiopian traditional coffee ceremony making explained in the nature of the study, traditional biomass mostly charcoal uses for two purposes: to boil water for making coffee and to smoke incense. To get the pleasant smoke, the incense is added on the fired charcoal. Customers enjoy the traditional ceremony of Ethiopian coffee that they experience while drinking coffee. One of the interview participants said about this tradition, *"It is a tradition and I also believe it has a cultural significance."* The traditional way of making coffee in the home is common everywhere in Ethiopia, both in rural and urban areas.

In urban areas they use electricity to roast coffee, but they use charcoal to enjoy the pleasant of the incense. Because it is not possible to get the pleasant smoke from the incense with electricity but through traditional biomass called charcoal. About the beauty of incense, the interviewee says, *"To be honest, I still use it because it is a culture and because it is beautiful."*

Figure 3. Traditional coffee ceremony and biomass utilization

Source: Photo from field work, 2022

5.6. Working conditions and traditional biomass energy utilization

In most cases, the type and location of work also determine what type of energy women should use. In some places there are women who traditionally prepare their coffee in front of their own house. These women are using electricity to prepare coffee though not used for smoking incense rather it is easy and proper using charcoal. As for the workplace, one of the participants said, *"As you can see, we work outside. We do not have any other option. I would like to use electricity without changing the traditional ceremony."* The focus group discussant added that it is possible to make coffee with electricity without changing the ceremony that people like to see. They think that the fresh grass spread on the ground and the incense make the ceremony beautiful. Even though WTCV wants to use more healthy and safe energy, the interests of the customers to enjoy the traditional ceremony and their place of work determine to use the traditional biomass energy called charcoal. In accordance with this study, Mekonnen and Kohlin (2009) confirmed that consumption habits determine the energy consumption pattern of consumers. This means that consumption habit is emanated from generation to generation through tradition. In this context, the traditional Ethiopian coffee ceremony is the one that is lovingly and colorfully passed down from generation to generation.

Figure 5. Working conditions of WTCV and biomass utilization

Sources: Photo from field work, 2022

5.7 Traditional biomass energy access and traditional coffee making

Ethiopian women traditional coffee vendors are using traditional biomass energy to prepare coffee on city streets, including in Bahir Dar, the study area. Therefore, they use different types of traditional biomass energy, mainly charcoal. Their access to traditional biomass energy for coffee preparation depends on several factors, mainly income. The analysis showed that access to traditional biomass is not very difficult, but income level prevents them from buying the desired products for coffee preparation. However, the binary regression analysis shows that income is not the only factor that determines the level and pattern of biomass energy consumption. There are other factors as well, but according to the participants, income determines the ability to afford to purchase biomass energy to make traditional street coffee. One of the participants said, *"I use charcoal. I can get it easily where I am. Because charcoal sellers are on the street. But sometimes the price goes up."*

The coffee vendors buy the charcoal from their customers. This is because, according to the participants, there are many charcoal sellers in the city who are constantly trying to get their business. Most of the time, the coffee vendors call their customers to bring charcoal to the place where they work. Regarding this, one participant said, "*I use charcoal to make coffee. I have customers who bring charcoal to me. Whenever I want, I call them, and they bring it to me".* In addition, coffee vendors bought charcoal from stores and unions when customers were not available when it was needed. Occasionally, farmers also sell charcoal to women traditional coffee vendors. Similar ideas are also raised that they contact their constant customer (biomass seller) to buy. Thus, the data collected through FGD also confirmed that, accessibility of charcoal is not that much difficult rather their level of affordability matters. This idea is also in line with the logistic regression analysis of the determinant factors that the income level increases their affordability to buy more biomass and increase type of biomass consumption pattern.

The research also mentioned many things about access and affordability of sustainable and healthy energy. As mentioned somewhere in the study, coffee vendors access depends on their ability to afford the price. Since they use traditional biomass, especially charcoal, for their business, they consume a lot of energy. Consequently, their consumption is different from that of households. Thus, coffee vendors are forced to spend money to buy energy from traditional biomass. Their affordability is affected by their income level. This is because access to energy is not guaranteed if one is not able to afford it. Ribot & Peluso's definition of access to capability explained it well as, "*access as the ability to benefit from things, including material objects, persons, institutions, and symbols"* (Ribot & Peluso, 2003, p. 153). In this

context, Guta (2012) stated that the reason why the majority of Ethiopians use biomass is because of lack of access to clean modern energy, high poverty and technological backwardness (p.134). According to the interview, high poverty (low standard of living) is the main challenge to buy biomass energy, like charcoal. Being resident in the capital city of the reginal state makes the biomass accessible however the inflation of the price affects their affordability. In line with the United Nations Sustainable Development Goal, UN (2021) explains the harm and importance of lack of access to energy is a barrier to achieving many other SDGs, especially for the poorest and most vulnerable communities. Access to modern energy lifts people out of poverty and improves their wealth, health, security, well-being, educational and entrepreneurial prospects; it also promotes gender equality and social, economic, and political equity (p.16).

5.8 Household size and women coffee vendors biomass energy consumption pattern

There are many factors that influence household energy consumption behavior. In this research context, the energy consumption behavior of women who traditionally make coffee was examined in relation to family size. The analysis also examined how family size affects women at the household and biomass consumption patterns. This is because in some ways they are interrelated and influence each other. Based on the thematic qualitative analysis, almost all participants responded that family size affects energy consumption patterns. The analysis revealed that those who have a large family are likely to consume a lot of energy. Since the price of electricity and improved energy is prohibitive, it is assumed that they additionally use other traditional energy from biomass. Although households with a small family consume many times more energy from biomass, households with a large family tend to supplement their daily consumption with other additional types of energy. In this regard, the participant said, *"I think the household size determines the energy consumption pattern because when there is a large household, the energy consumption also increases. Take my family; I have four family members. I cannot just use electricity in the house I rent."* Participants who are single are also aware of the relationship between family size and energy consumption patterns. One of the participants stated, "*Even though I am single, I know the impact. Large family uses more energy. I also use other types of biomasses, but there are differences."* The discussants are also stated that women have large number of households has large amount of energy consumption that affects their consumption pattern.

In this context, a study conducted by Tucho (2022) in Jemma, Ethiopia, on biomass energy use in urban households and fuel stacking showed that households mainly use firewood and charcoal for cooking. The proportion of each biomass type depends on a variety of circumstances. This was related to cooking frequency, family size, and type of meals (p.4). Kussa (2016) added, "*The most important factors in household energy consumption patterns include ... **household size**, ..." (p.35).* In support of Tucho and Kussa, Gamtsessa (2003, p.15) noted that household consumption patterns and energy demand in urban areas also confirm that the significant effects of traditional fuel prices indicate that extremely large shifts in consumption patterns are predicted. All types of energy use are positively associated with household size. However, this association is larger for traditional fuels than for modern fuels. This suggests that households with large family sizes rely more heavily on traditional fuels than households with small household sizes.

5.9 Type of cookstove and its health effects

Analysis of the data showed that the type of cookstove used, and the magnitude of health effects were related. The traditional coffee sellers use an improved cook stove called □□□□ (Fermilo). Even though they have used the improved stove before, the nature of the work, the time, and the place where they work have increased the health effects of using traditional biomass energy. During their work, women traditional coffee vendors are exposed to direct burns, which mainly affect their lungs and eyes. Regarding lung problems, one of the participants said, "*Using the traditional stove can lead to many problems such as skin rashes, shortness of breath, and many other problems*". For those who suffer from asthma, the problem is even more serious because the participant said, "*It changes my breathing. I have asthma, smoke triggers my asthma easily. I am struggling with an endless problem".* Regarding the relationship between energy access and health outcomes, Barron and Torero (2017) found that access to sustainable energy improves respiratory health and reduces infant and maternal mortality. However, increasing use of traditional energy resources has negative consequences for environmental quality and human health (p.23). According to Mazzoni and Isaac (2003), the health consequences of biomass energy are determined by two parameters: first, the amount of pollutants, which varies throughout the day depending on use, type of stove and fuel, and the effectiveness of a ventilation system or chimney. Second, the time spent in a polluted environment (p.2).

As they mentioned, the problem usually comes from the smoke, dust or ash and open fire. The problem that comes from the smoke mainly affects the respiratory system and eye problems. Most of the time it rains in summer in Ethiopia, which causes the coffee traders to have difficulty in making fire because the biomass they use gets wet, which increases the smoke. In this season, they use plastic from urban waste to make fire, which is too harmful by nature as it is collected from the dust. In this regard, one of the coffee vendors stated that, *"When we burn the coal, we use wood and plastic, it causes asthma and sinus"*. In attempting to burn the charcoal, the women also expose themselves to coffee vapor. This is indirectly related to the inefficient use of biomass energy for their coffee preparation. The interviewee, who has asthma and sinus, said, "*The steam from the coffee leaves bruises on our face."* Not only that, but her body sometimes gets burned by the charcoal fire. Another participant related to this said "*It burns our hands and feet and leaves a scar on our body. For example, I have scars on my legs and arms at different times"*. So, even though it is exacerbated by other factors, there is a correlation between the type of stove used and the extent of the health effects.

5.10 Conclusion

Sociodemographic characteristics showed that women in the age group of 18 to 28 years are the majority, which means that the oldest women are not that much involved. Marital status is also significantly related to age group, the majority are single, and their household status is female headed, because they are single or living with families or partners. The result of the model test shows that the model is significant at a p-value of 0.000 and 0.082 for Hosmer and Lemshow. The result of binary logistic regression shows that age group has a negative relationship with the energy consumption pattern of WTCV, that is, older female vendors are less likely to use multiple biomass energy sources than younger ones. Income is also positively related to the consumption pattern, which increases as income increases. In terms of women's consumption patterns, access to other types of biomass energy increases WTCV's likelihood of using multiple. In addition, health impact results showed that women have respiratory and body health problems. The tradition and working conditions also contribute to the health effects. Because consumers love to see the ceremony instead of just only drink coffee. In addition, the working conditions are also demanding, as the charcoal is burned during the summer season. Even though the women have the opportunity to use a variety of biomass energy, their working conditions, where they work with biomass all the days, exacerbate the health impacts.

Chapter Six: Conclusions

Traditional biomass energy is predominantly used in rural and poor urban households in developing countries. Biomass energy can be modern or traditional. Direct biomass burning poses various health risks to women, mostly for those who are responsible for social reproduction in the household. To be more specific to the target population of this study, women who traditionally sell coffee use biomass energy, mainly charcoal. This informal business is an emerging one in which high number of unemployed women are joining as a last alternative for their livelihood. The extent of the health effects of biomass energy depends on the amount of time spent with smoke and the location where it is ingested. Although WTCV work outdoors, they spend a lot of time with the smoke because they use it for business purposes. For their business to cook traditional coffee, they use different types of traditional biomass energy such as firewood, charcoal, municipal waste, etc. This study examined access to biomass energy, determinant factors to traditional biomass energy consumption patterns and health effects. Doing so, both quantitative and qualitative research approach were applied.

Based on the quantitative approach, the study found, the binary logistic regression result, the age of WTCV is negatively related to biomass energy consumption behavior. As women's age increases, their likelihood of using multiple forms of biomass energy decreases. Thus, older women tend to use only a single biomass rather than multiple energy sources. Income level is another important explanatory variable for biomass energy use patterns that shows a positive relationship with energy use patterns. The higher the woman's income, the more likely she is to use multiple biomass energies rather than single energy source. Access to firewood and municipal waste is also a factor that influences the consumption pattern and shows a positive relationship. Access to and availability of two biomass types increased the likelihood that women used more than one. However, they sometimes use other types of biomass energy as supplements. In addition to these, access to credit is also positively related to WTCV biomass energy use behavior: the more credit they receive, the more likely they are to use supplemental biomass energy. Even though their consumption behavior is determined by other factors, WTCV use biomass because they need the traditional ceremony for which charcoal is mandatory to do so. Thus, the binary analysis result showed that, WTCV are more inclined to the energy stacking model than energy ladder model.

The qualitative part has also shown that traditional biomass is used both in the household and currently for business purposes by WTCV in the streets of Bahir Dar city. In this context, it can be seen as biomass to make the coffee ceremony colorful. A good smell can be gained by burning incense on the charcoal. In addition to the reliance on traditional biomass, working conditions have also contributed to increase health impacts. Even the use of a slightly modified improved cooking stove does not protect from the health effects. More importantly, household size also determines the amount and type of energy and the pattern of consumption. The more the household has, the greater the challenge to afford the amount needed. Although income level, traditional values, household size, and working conditions has direct or indirect health impact on WTCV.

The paper provides an important contribution to academic and policy circles. The paper will serve as a cornerstone for other researchers by helping to address the health problem of traditional biomass and improve access to health-friendly energy for cooking on other areas too. Since the outdoor health effects of direct combustion of traditional biomass are unique, it will be important to interest researchers. In terms of policy contribution, the results of the study suggest that WTCV health should be a cross-cutting policy issue that can achieve sustainable development. To achieve the United Nations Sustainable Development Goals 7(1), both governmental and non-governmental organizations in the city administration should develop the right policies that help improve access to safe and healthy energy. To find the right solution, it should match the problem. Because outdoor health impacts of traditional biomass energy use are new and not adequately addressed in policies, programs and projects. Considering the alarming increase of WTCV in Bahir Dar City, development practitioners working on sustainable energy and health should include the outdoor health impacts of traditional biomass in their policy objectives.

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Appendixes

Appendix I: Questionnaire and interview guideline

Women traditional coffee vendors harmful utilization of traditional biomass energy for cooking in Bahir Dar City: Ethiopia

Erasmus university of Rotterdam

International institute of social studies

Master of Arts in Development Studies

Major:

Governance and Development policy

Dear Respondents:

This questionnaire is prepared to collect data for the thesis required to obtain the master's degree in Development Studies: major in Governance and Development Policy. The purpose of this questionnaire is to investigate women traditional coffee vendors harmful utilization of traditional biomass energy for cooking in the city of Bahir Dar: Ethiopia. The study is intended to generate data that can be used for academic purposes only, and depending on the results of the study, make plausible recommendations to the relevant agencies. The question mainly focused on the determinants of energy consumption pattern of women who traditionally cook coffee, and the health impacts of biomass energy.

The concrete and successful conduct of this study depends on the data we receive from you during data collection. Therefore, the researcher needs your assistance and cooperation to collect relevant information for the study. The reliability and validity of the study depends on your answers. So, please fill the questions carefully and correctly to ensure the success of this study. More importantly, please share your rational views with us, as this is very important for obtaining reliable data.

Thank you in advance for your cooperation!!

General Directions:

✓ No need of writing your name

✓ Please respond each question correctly and clearly and return as soon as you finished.

General Information:

Enumerator full name: _____ Signature _____

Date _____ Questionnaire Code_____

Sub-city _____

Cluster number: _____

Note: - Dagemawi Menilik (01), Tana (02), Fasilo (03), Gishe Abay (04), Belay Zeleke (05) and Atse Tewodros (06)

Part I: Socio-Demographic information. From the given alternatives, circle your answer or write your answer on the space.

1. Age of the respondent: A. 18-27 B. 28-37 C. 38-47 Above 49
2. Marital Status of the respondent: A. Unmarried B. Married C. Divorced E. Widowed
3. Family size of the respondent: A. 1 B. 2-5 C. More than
4. Educational status of the respondent: A. Illiterate C. Primary (1-8)
   D. High School (9-12)
   D. above diploma
5. Status of the household head of the respondent: A. Male- headed B. Female -headed
   C. Both
6. Monthly income of the respondent in Ethiopian currency (ETB): A. less than 500
   B. 500- 1000 C. 1000-1500 D. More than 1500

Part II: Questions related to the determinant factors on the energy consumption pattern of women traditional coffee vendors.

1. How long have you been working as traditional coffee vendor?
   A. Less than three months B. Six months- one year C. More than one year
2. How many types of biomass energy are you using?
   A. Single B. Multiple

3. What type of energy do you use? You can circle more than one.

   A. Firewood **B.** Charcoal **C**. Municipal residue D. All

   E. other----------

4. Do you easily access biomass energy for making coffee?

   A. Yes **B.** No

5. What type of stove do you use?

   A. Traditional **B**. Improved **C**. Modern

6. Do you have access to loan for your business?

   A. Yes B. No

7. If your answer for question five (5) is yes, did you borrow money from lending institutions within 12 months?

   A. Yes B. No

8. Does your household have a saving account with financial institutions?

   A. Yes B. No

Part III: Questions related to the health impacts of traditional biomass energy on women traditional coffee vendors.

No	**Questions**	**Responses**	
		Yes	**No**
1.	Cough		
2.	Noise irritation		
3.	Shortness of breath		
4.	Lung cancer		
5.	Eye related problem		
6.	Burning by fire		
7.	Pneumonia		
8.	Asthma		
9.	Other	_____	

Guideline questions for interview

1. How do you access traditional biomass energy for making coffee?

   If you have many options to access biomass energy, will you shift or use multiple? why?
2. Do you think household size determines energy consumption patterns? If so/not, why?
3. Do you think type of cook stove use for making coffee has health impact? If so/not, why?
4. What are the health impacts of using traditional biomass energy? If not, what is/are the reason?
5. What are your general comments about traditional biomass energy consumption for making coffee?

Guideline questions for focus group discussion

1. How do you have access to biomass energy to make coffee?
2. What are the health contributions of using improved cookstove in making coffee?

Appendix II: Binary logistic regression output

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	129.110	25	.000
	Block	129.110	25	.000
	Model	129.110	25	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	237.099[a]	.385	.514

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	14.009	8	.082

	FAMSIZE(2)	-.195	1.061	.034	1	.854	.823
	EDUCATION			4.798	3	.187	
	EDUCATION(1)	-.510	1.208	.178	1	.673	.601
	EDUCATION(2)	.340	1.202	.080	1	.778	1.404
	EDUCATION(3)	.034	1.225	.001	1	.978	1.035
	HHEAD			4.777	2	.092	
	HHEAD(1)	-.129	.827	.024	1	.876	.879
	HHEAD(2)	.808	.827	.955	1	.328	2.244
	INCOME			29.008	3	.000	
	INCOME(1)	2.792	.757	13.602	1	.000	16.319
	INCOME(2)	3.815	.821	21.584	1	.000	45.364
	INCOME(3)	4.039	.809	24.928	1	.000	56.786
	HLONGCOFF			.897	2	.638	
	HLONGCOFF(1)	.384	.408	.887	1	.346	1.468
	HLONGCOFF(2)	.238	.431	.306	1	.580	1.269
	FIRWOOD(1)	4.099	.966	17.992	1	.000	60.272
	CHARKOL(1)	-23.673	40193.164	.000	1	1.000	.000
	MUNIRESDU(1)	2.272	.911	6.217	1	.013	9.698
	ACCSBIOMA(1)	1.538	1.130	1.853	1	.173	4.655
	TYPSTOVE(1)	.096	3.174	.001	1	.976	1.101
	LOAN12MON(1)	1.505	.468	10.327	1	.001	4.506
	SAVING(1)	-.291	.375	.603	1	.437	.747
	Constant	19.735	40193.164	.000	1	1.000	372369666.869