

***Full Length Research***

**The Social and Environmental Impact of Charcoal Production: The Case of Mancha, Sere-Esho and Wachiga-Esho Kebeles in Offa Woreda, Wolaita Zone, Southern Ethiopia.**

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Population increase and deviations from the energy ladder model suggest that charcoal demand for heating and cooking in Sub-Saharan Africa will continue to increase through the year 2030 and beyond. Even with evidence of such high dependence across the continent, policies often fail to adequately address the social and environmental concerns associated with its life cycle. The objective of the study was to assess the socio-environmental impacts of charcoal production and to know the economic contribution of charcoal production to local charcoal producer as well as its impacts on surrounding environments in Offa Woreda some selected kebeles. Three Kebeles were purposively be selected by considering the status of wide spread of charcoal production and 97 sample were participated in this study. In the study area where most of the urban population uses charcoal and very little is known about the impacts of the life-cycle of the fuel on the livelihoods of the producers,who endure significant health, safety, and environmental risks for marginal gain. Extensive use of child labor, severe physical injury, gender disparities in income and education, and environmentally unsustainable practices are among the findings that high light the social and environmental impacts of production. Recommendations from these findings follow that high efficiency technologies should be piloted in communities that have the capacity to maintain and test their effects on environmental degradation. In addition, education programs in surrounding and effective land management strategies should be a high priority for both government and aid organizations, as the results of this study suggest. This study suggests a need to redirect policy efforts towards the social and environmental sustainability of an important contributor to GDP. These efforts would be particularly important in light of the new sustainable development goals. The evaluation of these findings along with current resources can help map a 'plan of action' for policy and decision makers alike in working to alleviate these pressures on rural communities.

**Key words:** Charcoal Production,Childlabor, Environmental impact, Extraction of fuel, Social Impact.

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## INTRODUCTION

### Background

About half the wood extracted world-wide from forests is used to produce energy, mostly for cooking and heating in developing countries but also for electricity generation in industrialized countries. The share of energy use from harvested wood is as high as 90 percent in Africa and more than 60 percent in Asia. Of all the wood used as fuel world-wide, an estimated 17% is converted to charcoal (FAO, 2016). Charcoal production is on the rise due to increasing demand in urban centres and by enterprises and in the absence of accessible alternative energy sources. Unsustainable wood harvesting and charcoal production cause forest degradation and deforestation, as well as the emission of green house gases (GHGs) along the charcoal value chain (AFREA, 2011).

Large-scale charcoal production, primarily in SSA, has been a growing concern due to its threat of deforestation, land degradation and climate change impacts. It is cited as the most environmentally devastating phase of this traditional energy supply chain, and despite increasing percapita income, higher electrification rates, and significant renewable energy potential, charcoal still remains the dominant source of cooking and heating energy for eighty percent of households in SSA. (Arnold et al, 2006; Zulu and Richardson, 2013). Charcoal produced using sustainably managed resources and improved technologies. However, it is a low net emitter of GHGs, there by helping to mitigate climate change while also increasing access to energy and food and providing income-generating opportunities (Iiyama et al., 2014b; Schure, Levang and Wiersum, 2014).

As a traditional fuel that has been used for hundreds of years, it serves as a life line for the rapidly increasing populations in the urban centers of the region, in addition to potentially significant portions of the rural population. Due to its low cost compared to other fuels like kerosene and liquefied petroleum gas (LPG) as well as other factors the demand for charcoal is expected to continue rising dramatically in the coming decades, despite best efforts by modern energy advocates (Ellegard, A and M. Nordstrom (2003). Charcoal use in Sub Saharan Africa (SSA) is predicted to double by 2030, with over 700 million Africans relying on it as a durable, preferred and cheap source of energy (*Ishengoma, E and R. Kappel. 200* ) with a forecasted increase in consumption, there is a great need to identify real versus perceived energy futures with respect to charcoal. In the case of Ethiopia, charcoal is produced from state-owned (public) forests and wood lands. There is little regulatory intervention from the government side. Moreover, production is more traditional and the producers have little idea that charcoal can be produced efficiently with

modern technologies. Although charcoal meets significant portion of urban households' energy needs in the country, and also support the livelihood of tens of thousands of rural households, it hardly attracted the attention of policy makers and development agents.

A good majority of urban population who use charcoal on regular basis doesn't seem to know how charcoal is made, from where it comes and its adverse environmental impacts. In cognizant of the potential environmental impact of charcoal production and marketing in the country, FSS commissioned this study with the objective to understand the environmental, social and economic implications of charcoal production, marketing and consumption in Ethiopia with aim to generate/increase awareness among the general public and incite a policy debate among concerned key stakeholders.

This study was shed the light on the status of current initiatives intended to mitigate adverse impacts associated with the charcoal production, particularly with in rural communities that often sustain disproportionate levels of impacts. Social and environmental indicators were assessed and policy recommendations provided based on findings of the study. An indepth analysis was done to investigate the current challenges the country faces in regards to social development and environmental protection in the context of charcoal production.

This study was also shown that large-scale transitions to modern energy sources only occur once a certain income threshold is met, while other studies have indicated that even with large increases in earned income, the majority of people continue to utilize charcoal. If a continued reliance on charcoal is suggested, there is an even greater need to evaluate and address the environmental and social issues associated with this highly influential, and largely informal, industry.

### STATEMENT OF THE PROBLEM

In the study area there are problems that come from over extraction of trees from surrounding forests by producers. Over extraction of forests or deforestation can cause degradation of forest resources such as loss of biodiversity, soil and water erosion, land degradation and frequent flood thus all may cause environmental and social impacts. These problems can be solved through the establishment of plantation forest place and studying these problems is important in order to establish plantation forest development.

The study was important in order to use material and input to develop plantation by users or charcoal producers in the the study areas. It identifies the level of community participation in developing plantation forest and provides basic information in which will serve as

above for further research and development in the study area. Current energy policy contradicts findings both in this study and across the region; charcoal production has a much higher social, environmental and economic impact that previously thought. In its current state, while the charcoal production is economically valuable, it has disproportionately adverse effects on social development of rural producers in addition to environmental degradation as a result of inadequate and disjointed policy measures that tend to benefit their urban counter parts.

Negative externalities resulting from improper land and resource management along with significant health and safety risks are born almost exclusively by the rural poor, who offer the benefit of cheap, reliable fuel. Organized efforts on the part of government and aid agencies highlight this imbalance, as most charcoal related programs are aimed at the dissemination of improved cook stoves for urban consumers or technologies that reduce pressure on forest resources. Since the study was not conducted regarding the problem in the study area before, the researcher was tried to assess the socio-environmental effects of charcoal production in study area and to know the economic contribution of charcoal production to local charcoal producer as well as its impacts on surrounding environments in Offa Woreda some selected kebeles.

## OBJECTIVE OF STUDY

### General objectives

➤ To assess the socio-environmental impacts of charcoal production and to know the economic contribution of charcoal production to local charcoal producer as well as its impacts on surrounding environments in Offa Woreda some selected kebeles.

### Specific objectives

- To assess environmental impacts of charcoal production in the study area.
- To identify the major constraints of charcoal production in the study area.
- To identify the opportunities of charcoal production in the study area.

### Research Questions

In view of answering the above mentioned objectives accurately, this study has the following research questions.

- What are the environmental impacts of charcoal production in the study area?

- What are the major constraints of charcoal production in the study area?
- What are the opportunities of charcoal production in the study area?

## Scope of the Study

The scope of the study was delimited to Offa Woreda especially most charcoal producer kebeles, such as *Mancha*, *Wachiga-Esho* and *Sere-Esho* kebele. This is mainly because of severity of the problems, limited availability of resources, and shortage of time to undertake the study on a wider scale .

## SIGNIFICANCE OF THE STUDY

Increasing energy production in the developing world has been a primary concern of national policy makers and international development agencies for many years. Improved other energy production including biogas, electric stoves and kerosien technology which are the results of scientific research must be available to farmers along with full information on how to use the new technologies. Establishing reliable electricity and fuel infrastructure should raise a number of concerns regarding the sustainability of essential industry not only its economic value, but the proper management of forest resource as well as livelihoods of those most responsible for producing this fuel. In general the result of these studies would benefit policy makers and help farmers to understand more about the social and environmental impacts of charcoal production.

## LIMITATION OF THE STUDY

The study was aimed at identify the determinant factors that affect small scale charcoal producer's access to charcoal production but there were a sort of limitations those hinder for proper collection of data for this study, some of the farmers were reluctant to frankly respond to some of the questions, they do not keep records due to memory lapse so that, some of the questions lacked the exact answers.

## RESEARCH METHOD

### Reserch Design

This study was designed to assess the social and environmental impacts of charcoal production in in Offa Woreda which is one of the Woredas of Wolaita Zone, in Southern Ethiopia. The researcher was used a cross-sectional community-based study comprised of both

triangulated quantitative and qualitative design and used descriptive data analysis and standardized question to collect data.

### Participants of the Study

Both primary and secondary data sources were used in this study. The data on the assessment of the socio-environmental effects of charcoal production and the economic contribution of charcoal production to local charcoal producer as well as its impacts on surrounding environments in the study area was collected from primary sources including household respondents. Additionally, the qualitative data to support the survey were also obtained from key-informants such as Rural and development officer and Kebele's Chair man and the FGD was conducted with farmers, community elders, small land holder farmers using a check list prepared for this purpose.

### Sampling method and sampling size

The study area three Kebeles were purposively be selected by considering the status of wide spread of charcoal production in these Kebeles of the Woreda and vulnerability to the problem based on the information obtained from the Woreda Agriculture and Rural development office and Food security program head. From several approaches to determine a sample, this study was applied a simplified formula by Yamane (Yamane, 1967 cited in Glen,1992) to determine the required sample size at 95% confidence level and level of precision 8.8%(0.088)

The total charcoal producer house hold found in three Kebeles were about 3151. So to determine sample size by using 10% level of error it was: -

Where n is sample size

N is population no.

e is level error

$$n = \frac{N}{1 + Ne^2}$$

$$n = \frac{3151}{1 + 3151(0.1)^2}$$

n = 96.92 ~ 97 of sample were determined.

### Data collection methods

The relevant data that are necessary for the research study was collected from primary and secondary data collection systems or methods.

### Primary data collection

There was two types of primary data collection methods in this study. These are questioner and interviews. The data was collected by preparing different questions regarding to the study matter and printed on paper based on sample size and finally the paper was distributed for those who can write and read and by making interview face to face.

**Secondary data collection:** Some relevant data was collected from written published and unpublished document or social development agent.

### Data analysis procedure

Both primary and secondary data collected for this research was organized and analyzed systematically by using data organization through both quantitative and qualitative method of data analysis and triangulated as well as the researcher checked the reliability of data gathered from both primary and secondary sources.

Accordingly, the quantitative data acquired through close-ended questionnaire items were organized and displayed in tables to be analyzed quantitatively through the application of statistical techniques of percentage and frequencies. While the qualitative data obtained and elicited through open-ended questionnaire items were from Focus Group Discussions (FGDs) and key informants analyzed through narration and qualitative descriptions.

## RESULT AND DISCUSSION

Despite numerous government reports on issues of charcoal production, no scholarly research has yet to address social, environmental and institutional trends impacting rural areas with respect to charcoal production in Ethiopia. Given the country's significant dependence on this fuel as well as the major economic impact on the industry it self has in the country, the following section identifies the livelihood challenges facing rural communities who participate in charcoal production for income generation. The major indicators and findings cited in the results section are those about which little has been investigated in published literature.

**Table 1.** Environmental Indicators Across the Study Area

No	Indicators	Number of respondent	Persent
1	Active cutting	30	30.298
2	Earth mound	45	46.392
3	Replanting	22	22.68
<b>Total</b>		<b>97</b>	<b>100</b>

Source: Own survey of 2019

As seen from Table 1, the majority of respondents actively harvest trees, which has been previously suggested as the primary indicator for deforestation associated with charcoal production. These trends still hold true on a regional basis, although a significant number of respondents in the study areas were collect wood from field trees in order to produce charcoal. Many respondents in the study area use earth mound kiln method. While the active harvest of forest trees for charcoal production does not have a direct link to deforestation, the subsequent use of cleared land will have a major impact on forest regeneration. Because over fifty percent of both men and women utilize this land for subsistence farming purposes and there is little regulation of forestry practices, these areas are at high risk for long-term deforestation. In addition, all respondents utilized traditional earth-mound kilns, which are constructed with organic materials (i.e. dirt, shrubs and grasses).

In general, charcoal production methods are highly inefficient and are a primary source of greenhouse gas emissions. While the majority of respondents reported that private land ownership, significant percentages of respondents in the study area reported that they produced charcoal on community-owned land. In most cases, private land was owned by a third party who did not reside in the community in question. As a result, despite clearing of land owned by another party, respondents felt it was not their decision to replant because they did not personally own the land.

**Table 2.** Charcoal Production by Individual per year

No	Individual	Number of respondents	Percent	Charcoal production in bags per year by individual	Percent
1	Men	50	51.5 %	300	56 %
2	Women	47	48.5 %	235	44 %
<b>Total</b>		<b>97</b>	<b>100 %</b>	<b>535</b>	<b>100 %</b>

Source: Own survey of 2019

These table illustrate that men produce 56 % or 300 bags of charcoal per year than women 235 bags per year, thus male are physically stronger than female, they cut many trees and dig large pit in order to make charcoal by earth mound method. The table also illustrate highest quantity of charcoal was produced by male than female in the study area, this means male were more responsible to environmental impacts.

**Table 3.** Social and Public Health Indicators

No	Indicators	Number of respondents	Persent
1	Physical injury	40	41.24
2	Sickness	25	25.77
3	Use of child labor	32	32.99
<b>Total</b>		<b>97</b>	<b>100</b>

Source: Own survey of 2019

All women used the term 'sickness' to express feelings of nausea while working to pack the charcoal. While charcoal production is the primary focus of this work, the consumption of wood fuels has significant livelihood and public health implications for rural communities who engage in production, especially women and young children. These populations most often sustain additional adverse effects associated with fuel combustion, including respiratory illness due to inhalation of high levels of particulate matter. The majority of all

respondents prefer to use wood exclusively as a cooking fuel, most often because it is cheap and widely available.

Despite its use in varied environments (i.e. closed rooms vs. out doors), women remain at higher risk of these illnesses as compared to men, as they are typically responsible for meals and use wood as a cooking fuel. One of the major benefits of charcoal is that it produces much less smoke, and therefore particulate matter, when compared to wood. The use of axes and chain saws, combined with heavy lifting, extremely high temperatures

and lack of safety training create unsafe working conditions, as supported by a 75% injury rate among all respondents. Common injuries among affected individuals were moderate to severe lacerations and burns of the lower extremities that, in a developed context, would require immediate medical attention. Lack of adequate treatment often limits participation in income generating activities for an extended time, usually due to infection and vulnerability to other hazards.

In addition to visible external injuries, the majority of women expressed that they felt dizzy, light headed and nauseated while, and for some time after, engaging in production tasks; these symptoms were not voiced by male respondents. Upon further discussion, this 'sickness' had become a chronic issue; while dehydration, hunger and physical exhaustion may be responsible for these issues, there may be a connection to poisoning from carbon monoxide and other gases released during combustion. The completion of pyrolysis in traditional coal-producing communities requires women to be in close contact with bulk charcoal as well as 'fines', smaller pieces of discarded charcoal, and powdered residues.

Hampson et al. (1994) conducted an early study showing that even well ventilated burning of charcoal briquettes resulted in high levels of CO poisoning; minorities and those of lower income brackets sustained greater impacts. Acute exposure to compounds including carbon monoxide and levels of particulate matter that are often fifty times higher than the U.S. Environmental Protection Agency standard of outdoor air quality will likely lead to these symptoms; chronic exposure, however, can have significant impacts on certain human development factors, like cerebral development and has

grave implications for maternal health, including low birth weights. Further research is required to investigate the cause of these symptoms in charcoal producers and whether they are linked to current community health issues.

### Child Labor

Of all respondents surveyed, 57.1% routinely utilize child labor in the production phase. While children typically engage in less physically intensive processes (sorting and packing), they are by no means safe from serious health risks. Inhalation of toxic gases in young children is often more detrimental to healthy physical and mental development. In addition to severe public health risks, engaging in production processes limits time spent in primary and secondary school. This has grave implications for the already-low rates of education in charcoal-producing communities; the forecasted increase in charcoal demand in the coming years may expose more children to serious injury, while preventing them from engaging in educational activities, unless the social effects of energy are holistically considered in national policies.

### Gender Disparities

While the absolute impacts sustained by charcoal-producing communities are significant, there are further disparities related to education, employment and income generation among men and women. Consistent with evidence found across the region, this study finds significant differences in the ability of men and women to maintain already-low standards of wellbeing in rural areas.

**Table 3.** Education and Employment Indicators

	Category	Men % (n)	Women % (n)
1	Education	None	31.9
		Primary	21.28
		Middle	36.17
		High school	10.62
		<b>Total</b>	<b>100</b>
2	Employment	None	21.28
		Farmer	63.83
		Trade	14.89
		Motor bike rent	0
		<b>Total</b>	<b>100</b>

Source: Own survey of 2019

The common trend of gender inequality found in both urban and rural areas of developing countries is supported with respondent data. Both educational and income generating opportunities are crucial for not only rural development in general, but particularly for women and young girls. The 31.9 % of women had received no education (compared to 20 % of men); in each educational category there after, male educational attainment was significantly higher compared to females.

In addition, most of women were either not employed (21.28) or worked as subsistence farmers (63.83%). An equal percentage of males self-identified as unemployed, with 16% working as subsistence farmers and 24% engaged in trade positions (carpenter, electrician, etc.). No females held on trade positions or were pursuing higher education.

**Table 4.** Income Generation per bag of Charcoal production.

Individual	Charcoal per kg in bags	Income per bag sold in ETB	Percent
Men	300	3000	54.25
Women	253	2530	45.75
<b>Total</b>	<b>553</b>	<b>5530</b>	<b>100</b>

*Source: Own survey of 2019*

The above table illustrate that there was significant difference in producing charcoal between men and women, that mean 300 bags of charcoal was produced by men and 253 bags of charcoal was made by women producers. Not only in producing many bags of charcoal, men were differ in income that they had earnd, 3000 ETB was sold by men or (54.25 % ) of income was earned and 2530 ETB was sold by wome or (45.75 %) they had earned.

This finding supports the trend of lack of bargaining power typically found in rural communities, particularly for women attempting to sell charcoal. In addition, males were much more likely than women to paid cutter of trees, likely due to their higher earnings and social networks within, and outside, the community. Given greater access to these tools, this is likely to result in higher earnings for men per unit sold. Further differences in income generation by respondent suggest a need for more research on the true determinants of market price, especially given the differences in production volume.

### Current policy efforts on charcoal production

Current methods of charcoal production and their associated impacts; deforestation, land degradation and their impacts on climate change; as well as negative health outcomes of using traditional fuels have gained most of the attention of policy-makers and have ultimately painted this highly influential energy sector in a negative light in the context of realistic energy futures. In many cases, the infancy of energy and forestry policies requires charcoal, or wood fuels in general, to be acknowledged as a primary energy provider. Ambitious targets of electrification, emissions reductions and use of renewable energy blanket the bulk of energy policies in countries that do not yet have the institutional, financial or community capacity to realistically achieve these goals;

the majority of these countries have not yet conducted a comprehensive emissions inventory, limiting their credibility and effectiveness in developing emission reduction strategies.

Similarly, few countries recognize charcoal production as a major greenhouse gas emitter, while large-scale production has been cited as a significant contributor. Certainly, electrification and the development of modern energy sources should be a part of the way forward. However, a balanced energy transition is essential in alleviating environmental and social pressures that remain primary concerns for many governments across the region. As such, policies for the charcoal end-user should be equally complemented with policies that promote public health improvements, environmental protection and greater opportunities for access to a market that will continue to grow in the coming years.

### CONCLUSION AND RECOMMENDATIONS

Ethiopia will be highly dependent on charcoal as a source of heating and cooking fuel for the foreseeable future. Current energy policy contradicts findings both in this study area and across the region; charcoal has a much higher social, environmental and economic impact that previously thought. In its current state, while the charcoal industry is economically valuable, it has disproportionately adverse effects on social development of rural producers in addition to environmental degradation as a result of inadequate and disjointed policy measures that tend to benefit their urban counterparts.

Negative externalities resulting from improper land and resource management along with significant health and safety risks are born almost exclusively by the rural poor, who offer the benefit of cheap, reliable fuel. Organized efforts on the part of government and aid agencies, as

well as organizations like the National Charcoal Union, highlight this imbalance, as most charcoal related programs are aimed at the dissemination of improved cook stoves for urban consumers or technologies that reduce pressure on forest resources.

These policies fail to address indirect, but significant, impacts sustained by the large rural labor force, who depend often exclusively on income generated from charcoal production. In urban areas, charcoal retailers are common place, with very few opportunities for extortion, as government officials are often in lines with the rest.

Despite these grim findings, there is hope found in the willingness of communities to both engage with local organizations as well as embrace sustainable energy technologies, such as high efficiency kilns, that have potential to dramatically reduce adverse social and environmental impacts associated with charcoal production. As such, policies for the charcoal end-user should be equally complemented with policies that promote public health improvements, environmental protection and greater opportunities for access to a market that will continue to grow in the coming years.

Proper land use management techniques, such as replanting, along with utilization of high-efficiency kilns, can significantly lower the impacts associated with an industry that is vital to the national economy. The evaluation of these findings along with current resources can help map a 'plan of action' for policy and decision makers alike in working to alleviate these pressures on rural communities.

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