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Socio-Economic Effects of Prosopis Charcoal Production and Marketing: The Case of Gewane *Woreda*, Afar Region

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Acronyms

FAO	Food and Agricultural Organization
UNDP	United Nations Developmental Program
IAS	Invasive Alien Species
ANRS	Afar National Regional State
MAV	Middle Awash Valley
WER	World Energy Resource
CRGE	Climate Resilient Green Economy
FGD	Focus Group Discussion
HH	House Hold

Abstract

Socio economic impact of Prosopis charcoal production and trade: the case of Gewane woreda, Afar region

Mohammed Detona

Addis Ababa University, 2014

The main purpose of this research is to understand how and to what extent charcoal production and trade has been affecting the livelihood of pastoral communities in 'Galeila Dora' Kebele Administration, Gewane Wereda, Afar Regional State. The study focused on how the local communities respond to the negative effects of charcoal production from indigenous trees. Household surveys, focus group discussion, and key informant interviews were made to collect some valuable data and information relevant for this study. Besides, observation was also made to verify what has been actually happening to the prosopis and indigenous trees in the study sites. The results reveal that the benefits and profits obtained from charcoal production from prosopis tree, which was formally initiated in this area, attracted the interest of local communities, manage to improve the status of their livelihood further attracted by this business which later turned their face to the illegal cutting and burning of indigenous trees for better incomes from the sale of charcoals of high quality and highly demanded by the consumers in urban areas. As time goes on, the illegal cutting of indigenous tree currently reached an alarming stage requiring corrective action to be taken. Owing to this fact; this study suggested that the regional and local government officials need to design systematic approaches on how to manage the indigenous trees. Moreover, taking legal action on charcoal producers from legally prohibited indigenous trees other than the permitted prosopis tree is urgently needed. Therefore, all government officials at all levels of administration need to discharge their political commitment in close consultation with the local communities in ensuring to encounter the aggressive removal of indigenous tree before their complete destruction.

CHAPTER ONE

Introduction

1.1 Background of the Study

Poverty is one of the greatest moral challenges we face today, with a sixth of the world's population living on less than $1 per a day (World Bank, 2006). Over 90 % of the 1.2 billion living in poverty worldwide rely on forests to some extent for subsistence needs (World Bank, 2002). The extraction of timber for wood fuels accounts for 61 % of total wood removals (FAO, 2005).This highlights the importance of these fuels in the energy mix of many countries (Richard and Herd, 2007).

The most important environmental problems in Ethiopia include climate change, and degradation, overgrazing and deforestation, indoor air pollution and water pollution. Other, important environmental problems include loss of biodiversity and ecosystem services, spread of invasive alien species, urban outdoor air pollution (mainly in Addis Ababa), and toxic household wastes (Cesar and Ekbom, 2013).

Ethiopia's government has shown commitment to the protection of the environment by establishing environmental protection agencies at federal level and in all regional states, as well as formulating various environmental proclamations and ratifying important environmental conventions. Moreover, establishment of the national strategy Climate Resilient Green Economy (CRGE) gives a strong indication of Ethiopia's high ambitions and strive to move towards a greener economy.

However, Ethiopia faces many challenges in terms of lack of human and financial capacity. Environmental governance needs to be improved at all level. Weak capacity in environmental management, law enforcement and monitoring are key challenges that need to be addressed in order to meet MDG targets and move towards a greener economy (Cesar and Ekbom, 2013).

Moreover, pollution, natural resource depletion and human health are closely linked, and particularly so in Ethiopia, where the environmental degradation poses a major risk to human health. Indoor and outdoor air pollution, unhygienic or unsafe food, improper waste disposal, absent or unsafe vector control and exposure to chemicals are major environmental health hazard and adequate water and access to sanitation and hygiene is of outmost importance for people's health. Biodiversity provides goods and services such as food and medicinal plants that promote human health. However, rapid population growth, urbanization, agricultural expansion, land degradation and climate change are threatening these services. This indicates that environmental-health issues deserve a high priority consideration in national development (Cesar and Ekbom, 2013).

Among others, charcoal production is a big threat because it targets specific preferred species found in natural forests and woodlands, most of which are poorly managed. The result is unsustainable harvesting. In drier areas, where the regenerative capacity is lower, unplanned and unmanaged charcoal production accelerates the processes that lead to desertification. In addition, regulation of charcoal production is uncoordinated and there is little investment to make business more efficient and cost-effective. This makes charcoal extraction unsustainable and contributes to its negative image (Mugo and Ong, 2006).

The growing demand for charcoal in Sub-Sahara African countries has resulted in localized deforestation in vulnerable areas, particularly surrounding urban centers in Sub-Sahara African (SSA). In these locations forest degradation and the associated socio-economic impacts of those dependent on these resources has stimulated development initiatives to address these issues through linking poverty, livelihoods and energy with sustainable resource management (SEI, 2002).

Ethiopia with landmass of 1.1million square kilometers is third giant and second populous nation in the Sub-Saharan Africa with estimated population of about 85.5million. United Nation Development program (UNDP, 2010), The Food and Agriculture Organization (FAO) has estimated that for the world as a whole total charcoal production in 2009 was 47million tones and increased by 9% since 2004. Africa accounted for an overwhelming share of

world's charcoal production (about 63% of global production) in the 2004. Ethiopia is among the leading producer (8%) in the world production of charcoal following Brazil (11%). FAO (2009) report also put Ethiopia among the five top world's wood fuel producing country in the period 2004-2009 only next to India(16%), China (7%) and Brazil (11%) in that order.

Ethiopia according to the same source had 4th rank in its share to global wood fuel production contributing about 5% in the covered period. Fuel wood is preferable energy source for industrial heating in small and medium scale industries (e.g. Soap industry). Charcoal is also utilized by small cottage and craft industries. Charcoal production is inevitably followed by associated environmental problems such as the depletion of preferred species, forcing producers to resort to lesser-used species and, critically for livelihoods, food-bearing trees. Where charcoal is produced in quantity, localized deforestation has been noted (Davison *et al.*, 2013).

More importantly, Charcoal production has far-reaching impacts extending across a range of social and environmental issues. These include health problems of charcoal producers associated with air pollution, environmental change associated with greenhouse gas emissions and the depletion of local forests and woodlands, and social problems related to migration, labor and gender (BTG, 2010).As a result Ethiopia's economy is, therefore, exposed to unsustainable use of natural resource.

The people around Afar region use *Prosopis juliflora* as a fuel wood and for other many purposes. Afar Region, especially Gewane Wereda, produced huge amount of charcoal and transported and sold towards many parts of the country and gain benefits. However, the burning issue here is that, indigenous varieties of tree species such as acacia are burned and converted to charcoal. Thus, the main purpose of this study is to identify socio-economic effects of charcoal production in Gewane *Wereda*, Afar National Regional State (ANRS).

1.2 Statement of the problem

Charcoal production and agriculture contribute to woodland degradation and deforestation in Ethiopia. The major reasons for deforestation in the country are the clearing of forests and woodlands for cultivating crops and the cutting of trees and shrubs for various purposes, notably for fuel wood, charcoal, construction materials, etc. In Ethiopia, fuel wood and charcoal constitute the most important sources of household fuel meeting the energy need of rural and urban households. A wood energy survey of 1996/97 indicates that 230,000 tons of charcoal is used every year in the country. According to the Ethiopian Forestry Action Program, fuel wood including charcoal contributes 66% and 62% of the energy consumption in rural and urban areas, respectively (Abebe and Endalkachew, 2011).

Accordingly, charcoal production is one of the major reasons for deforestation in Ethiopia because fuel wood and charcoal constitute the most important sources of household fuel demands of rural and urban households of the country. Taking this in to consideration, there is a huge amount of charcoal produced and used for home based consumption, and transported and sold to other parts of the country.

The study area is among those who take the lion's share of contribution to the production and selling of charcoal where the activity is viewed as mainly contraband which is channeled to different parts of the country. The main problems associated with charcoal making are deforestation of indigenous trees in the name Eradication of noxious weed especially prosopis, environmental pollution, wild animals habitat destruction, conflict between afar agro pastoralist and highlander, deprivation of human rights, lack of political commitment and tragedy of social problems and etc, manifested as pressing problem.

Apparently, producing and selling of charcoal can have social impact like conflict between residents living around the charcoal extraction area, may be due to low abundance of the trees where charcoal can be produced and high demand of the people either for home based consumption or sell. It can also have economic impact in the area.

When trees are cut and removed for the purpose of making charcoal, people can get money from sell of the charcoal, and the money they get can aid them lead their day to day activity, but it has a minute short term positive impact. Natural resource degradation and the associated problems such as soil erosion, soil fertility degradation, expansion of desertification, flooding and in-door and out-door air pollution, migration of wild animals from the area will be the serious and negative impact of charcoal production. Hence the ecology in the area will be damaged. On the other hand, tree species like prosopis juliflora, that has economic, social and ecological disadvantage to the area of Afar region, it is better to produce charcoal from it and use for either home based consumption or for sale, because the species is spreading fast from year to year.

Therefore, it is necessity to recognize the status of charcoal production, charcoal trade system and main role of actors involved, impacts of the charcoal trade on pastoral livelihood, impact on forest cover and biodiversity, socio-economic impact (such as social conflicts, economic gain etc.), as well as efforts of government underway at present in order to provide evidence based solution and policy recommendations. Nevertheless, so far no attempt has been made to study and understand the socio-economic and ecologic impact of charcoal production in the study area. Therefore, the main aim of this study is to assess and investigate the socio-economic impacts of charcoal production in GewaneWereda, Afar National Regional State (ANRS), Ethiopia. The result of this study is expected to contribute to the designing of appropriate and relevant interventions by the government, and other development practitioners in the study site in particular and other similar areas at large.

1.3 Objective of the study

1.3.1 General objective of the study

The general objective of this study is to investigate the socio-economic effects of charcoal production, the case of Galila Dora Kabele, Gewane *Wereda*, Afar National Regional State.

1.3.2 Specific objectives

The specific objectives of the study are:

1. To assess the impact of the charcoal production on livelihoods,
2. To investigate local communities' perception of the impact of charcoal production on indigenous tree,
3. To investigate the role of charcoal production to conflict situations in the study area, and
4. To assess government's regulations regarding the use of prosopis for charcoal production and trade.

1.4 Research questions

The following research questions were formulated and addressed in the course of this study:

1. What is the impact of charcoal production on agro-pastoralist communities' livelihoods?
2. What is the perception of the local community towards negative impact of charcoal production on indigenous tree?
3. What is the role of charcoal production to conflict situation in the study area?
4. Do existing rules and regulations concerning the use of Prosopis for charcoal apply to the local context?

1.5 Significance of the study

Generally, this study focused on the socio-economic impacts of charcoal production on agro-pastoral communities in the study area. Undertaking this study is vital because it contributes to raising the attention of the local communities and concerned bodies including government and non-governmental organizations on social and economic impacts of charcoal production. The result of the study would serve as a reference material for further studies related to the short-term and long-term socio-economic impacts of charcoal production on people's livelihoods. In addition, this research could be instrumental in suggesting some major strategies/mechanisms of tackling socio-economic impacts of charcoal production and selling on locals livelihoods.

1.6 Scope and limitation of the study

This study was conducted in the Galila Dora Kebele of GewaneWereda, Afar National Regional State of Ethiopia. The study was aiming at the investigation of the socio-economic impact of charcoal production in the study area. Despite, many challenges posed by charcoal production in nationwide, this study restricted to identify socio-economic impacts of charcoal production solely to Galila Dora Kebele Administration. This was owing to limited budgets, time and geographical factors. Therefore, the finding of this not generalized at national and regional level, but it is useful to design appropriate approaches, intervention strategies to cure the devastation of indigenous trees in the study area in particular and other similar sites in general.

1.7 Organization of the thesis

This introductory chapter is followed by chapter 2, which deals with definitions of terms, concepts and sustainable approaches to charcoal production and biomass, nature and process of charcoal production, significance of charcoal in national development, environmental and socio-economic impacts of charcoal production, charcoal utilization pattern in Ethiopia, charcoal production in relation to prosopis and conceptual framework of the study. Chapter 3 deals with description of the study area, source and methods of data collection, sampling procedures (techniques), and methods of data analysis. Chapter 4 presents results and discussion. Finally, chapter 5 presents summary, conclusion of the study and recommendation with policy implication.

CHAPTER TWO

2 Review of related literature

2.1 Overview

Having established the general overview of the study in the previous chapter, this chapter seeks to provide broader information on the concepts and sustainable approaches of charcoal production. The chapter further examines institutional issues in sustainable biomass projects in other countries and the possibilities of replicating the strategies in Ethiopia, mainly focusing on Gewane Wereda, Afar region. Global trends in fuel wood consumption and environmental effects emanating from charcoal production will be examined in the chapter.

2.2 Concepts and Sustainable Approaches to Charcoal Production and Biomass

Charcoal and firewood are collectively referred to as fuel wood, a major source of cooking and heating energy for most urban households in sub-Saharan Africa (Davison *et al.*, 2013).In the theoretical and empirical literature there are contrasting views on biomass resource use for basic human energy needs. The early proponents poised pessimistic view towards biomass fuel consumption. This band of theorists viewed that reliance on biomass resources for basic energy need deprives health and other wellbeing of users and also degrade the environment. Optimistic insisted that sustainable harnessing of biomass with the aid of modern technologies; offer renewable energy (Dawit, 2012).

The same source indicate that biomass resources comprise of residues from agriculture, harvests from forest (in the form of firewood, charcoal, residues), crop residue, energy crops, animal manure, residues from agro-industrial and food processes, municipal solid wastes, and other biological resources. These resources could be directly utilized for basic energy needs (e.g. fire wood, charcoal, dung cake etc.) or transformed into invaluable renewable energies (e.g. biogas, bio-fuel, bioelectricity, hydrogen energy, etc.) for household as well as industrial and transportation sectors.

2.2.1 Nature and Process of Charcoal Production

Charcoal "is the general term for a range of carbonized materials, with varying combustion and dark properties". It is usually produced by raising the temperature of wood beyond the point at which many of its organic components become chemically unstable and begin to break down. The details of this process, called pyrolysis, are still incompletely understood. Most of the newly formed materials are vapour. The material left behind is a black, porous charcoal that retains the original form of the wood but has just one fifth the weight, one half the volumes, and about one third of the original energy content (Amanor*et al.*, 2002). To prevent most of the wood from igniting during production (pyrolysis), charcoal must be made in an environment of restricted air flow (Stephen, 2011).

In most of the developing world, charcoal makers use traditional means or build temporary earthen kilns for each batch. The wood is stacked compactly in a pit or on the ground. The stack is covered by straw or other vegetation, and then buried under a layer of soil. It is ignited with burning embers introduced at one or more points at the bottom of the stack. The task of the charcoal maker throughout the ensuing "burn" is to open and close succession of vent holes in the soil layer to draw the fire evenly around the wood stack, heating the wood while burning as little of it as possible. Charcoal can be produced from wood and other biomass types in a process called carbonization. Carbonisation is the method of burning wood or other biomass in the absence of air after which it breaks down into liquids, gases and charcoal (FAO, 2000).

Charcoal is traditionally produced in earth, brick or steel drum kilns in batches from about 1 to 5 tons. Common kiln types and production methods are detailed in e.g. (FAO, 1983) and recently in (UNDP, 2010). Fuel wood is gathered and cut to size, and placed in an underground or above ground kiln. The kiln is fired and the fuel wood heats up and begins to pyrolyse. The kiln is mostly sealed, although a few air pockets are initially left open for steam and smoke to escape. As the kiln emissions change colour, the charcoal producer may seal some air pockets. The production process may take up to a few weeks. About half of the energy in the fuel wood is typically lost in the process (but the charcoal produced has higher energy content per unit mass). When the process has ended, the kilns are opened or dug-up and the charcoal is removed. The

resulting charcoal resembles smaller, lighter pieces of blackened wood. These will have higher energy content by weight than fuel wood (Kammen and Lew, 2005).

In Africa, a limited number of people consider charcoal production as their main economic activity, while a majority engage only occasionally as a means to generate income, particularly in times of financial stress, such as when making large payments for things such as medical costs, funeral expenses, food supplies in the event of poor harvests, marriage ceremonies, and school fees. Cash income from charcoal may act as a form of insurance against crop failures (FAO, 1983).

In general, the charcoal producer brings the charcoal in bags to the roadside from where it is transported by truck, other motorised vehicles or by bike to the urban centres. Wholesalers or transporters often contract charcoal producers, but they also work and sell their products individually. The majority of charcoal is sold to large or small-scale transporters. Some large-scale transporters are also wholesalers. These wholesalers then pass the charcoal on to smaller-scale retailers and consumers (WB, 2009). The retailing of charcoal offers trade opportunities for many people, in particular women (BTG, 2010).

2.2.2 Wood species used for charcoal production

Charcoal production is a big threat because it targets specific preferred species found in natural forests and woodlands, most of which are poorly managed. The result is unsustainable harvesting. In drier areas, where the regenerative capacity is lower, unplanned and unmanaged charcoal production accelerates the processes that lead to desertification. In addition, in most countries of the region, regulation of charcoal production is uncoordinated and there is little investment to make business more efficient and cost-effective. This makes charcoal extraction unsustainable and contributes to its negative image (Mugo and Ong, 2006).

The critical dimension of tree loss related to charcoal production centres on preferences for specific tree species. While almost all trees can be used for charcoal production, Table 2.1 shows those most in demand by charcoal producers (Syampungani, 2008). Preferred species must produce long-lasting embers that emit a lot of heat (Gumbo *et al.*, 2013).According to charcoal

producers, woody tree species for charcoal production should have a long burning time, a very high heat value and produce little smoke, sparks or ash(Malimbwi*et al.*, 2005).. The most commonly used tree species for charcoal production, including fruiting and commercial timber speciesare listed in Table 1.

Table 1. Tree species used for charcoal production

S.No	Tree species	S.No	Tree species
1	Acacia nigrescens	22	Erythrophleum
2	Acacia sieberana	23	Suaveolen
3	Acacia spp	24	Julbernadia
4	Afzeliaquanzensis	25	globiflora*
5	Bauhinia thonningii*	26	Julbernadia
6	Bosciasalicifolia	27	paniculata*
7	Brachystegiaboehmii	28	Khayaanthotheca
8	Brachystegia	29	Lanneaschimperi
9	spiciformis*	30	Lanneaspp
10	BurkeaAfricana	31	Markhamia
11	Combretum	32	Obtusifolia
12	Apiculatum	33	Millettia
13	Combretumfragrans	34	Stuhlmannii
14	Combretumspp .	35	Ozoroaobovata
15	Crossopteryxfebrifuga	36	Parinaricuratellifolia*
16	Cussoniaarborea	37	Pericopsisangolensis*
17	Dichrostachyscinerea	38	Pterocarpusangolensis
18	Dombeyashupangae	39	Pterocarpusrotundifolius
19	Uapacakirkiana*	40	Schreberatrichoclada
20	Sennasingueana *	41	Sclerocaryabirrea
21	Dalbergiamelanoxylon		

Source: Davison *et al.* (2013)

It is not common for these species to rapidly remove from woodland once charcoal production begins, which affects the species composition of woodlands (in this case, Miombo) (Chidumayo, 1997; Hibajene and Kalumiana, 2003; Syampungani *et al.*, 2008).

2.2.3 Sustainable Forest Management and Charcoal Production

The term sustainable resource management is a broad concept in development planning. This is because; it has different interpretations by different people and at different places. In development thinking, The Brundt land Commission sees it as a system of forest management that meets the needs of the present generation without compromising the ability of future generation to meet their needs (Todaro and Smith, 2009). The United Nations General Assembly Agenda 21 echoed the role of sustainable forest management in development in 1997 (Stephen, 2011).

The UN General Assembly looked at the term based on some key principles such as:

Principle 1

Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

Principle 2

States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies. They have a responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

Principle 3

The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations. These principles reinforce the importance of forest resources to nations' social and economic development hence the need to sustainably use those resources for the benefit of the present generation without depriving future generation the opportunity to also take advantage of the benefits of forest resources. That is, the

harvesting of fuel wood for present consumption should not compromise the ability of future generation in getting access to forest resources for fuel wood (Stephen, 2011).

Analysis of the wood fuel data over the decades has revealed certain trends in the wood fuel consumption. Firewood is the predominant fuel used in the rural areas of developing countries, whereas charcoal is the preferred fuel in urban centres replacing firewood as incomes rise (Kituyi, 2004; Arnold *et al.*, 2006). This transition is often referred to as the "fuel ladder" (Figure 3) and describes the situation where firewood and charcoal, which occupy the lower rungs of the ladder, are then substituted by kerosene, gas and commercial electricity as you rise up through the rungs(Richard, 2007).

Ayodele *et al.* (2009) revealed that sustainable exploitation of wood fuels involves the production of charcoal without endangering the natural environment. They stressed that sustainable management of forest is the maintenance of forest area and its species composition over a certain period of time (Stephen, 2011).

2.3 Significance of Charcoal in National Development

Environmentalists feel that charcoal production should be stopped because of its destructive nature as presently practiced (Achard *et al.*, 2002). However, Arnold and Persson (2003) asserted that both rural and urban dwellers in some developing countries have developed a strong appetite for charcoal use. Therefore, attempts to ban the production or the use of charcoal will be mostly unsuccessful mainly due to the interplay of socio-economic interests. Since operators can use free raw materials (wood from natural forests or farm clearing) and turn them into a marketable commodity in high demand, there is the need to have much respect for the sustainability of the resource.

The Food and Agriculture Organisation (2000) points out that, charcoal is a very important energy source for households. Its saturation ranges from 54 to 71% in urban areas and it is the main fuel for more than 1 million families in Sub Saharan Africa. It was also noted as a valuable commercial fuel, with an annual turnover of some US$60 million at current market prices. The FAO assumed that if 80% of this amount corresponds to labour payments at US$1.50 per day, its

production and marketing create some 144,000 permanent jobs earning twice the average minimum wage (US$0.75 per day) of most sub-Saharan African countries as of the year 2000 (Stephen, 2011).

The implication of this is that as the economies of developing nations grow, one would expect to see a decline in the wood fuel mix of the country (Girard, 2002). This has indeed been observed in Asia where the consumption of wood fuels is declining in favour of alternative fuels, reflecting the rapid economic growth of the region since the 1980s However, in Africa, one of the most marginalised regions in the world, economic growth has been slow and wood fuel consumption is increasing (SEI, 2001; Kituyi, 2004). This growth is associated with the rural to urban migration found in many African countries combined with low incomes and savings, which inhibit the transition to others fuel types. As a result, Africa's wood fuel dependence is likely to persist for decades to come, which could have significant consequences for forest resources and the rural livelihoods dependent upon them (Richard, 2007).

Fuel wood use is dominant in rural households. More than 2.2 million families depend on it for cooking and heating. And at least 280,000 of them use it for small-scale processing activities, such as fish smoking, gari making, pito brewing, akpeteshi distillation, pottery making, oil extraction (from palm fruits, coconut, groundnut, shea butter), thus making a significant contribution to food preservation, food security and cash earnings for rural and urban people (FAO, 2000).

In addition, there are some 600,000 small-scale enterprises in commercial activities, such as chop bars, street food and grills, which depend on fuel wood or charcoal as their main source of energy. Today wood energy still contributes directly to poverty reduction (Broadhead *et al.*, 2001) especially in developing countries. In Ghana, it has been estimated that, wood fuel mainly in the form of charcoal and fuel wood make up 60 present or more of the total natural energy consumption (Energy Commission, 2010). More than 2 billion people used fuel wood or charcoal as energy to cook and preserve food (Broadhead *et al.*, 2001). Wood energy thus helps households in attaining food security (Stephen, 2011).

A fuel wood shortage has in some cases/reduced households to one cooked meal per day in South Africa (Broadhead *et al*, 2001). It was also reported that, as much as 575,000 persons are directly engaged at various levels by wood fuel production, full-time or part-time (paid or unpaid) across Africa (Stephen, 2011). On a global scale, (Broadhead *et al*., 2001) reported that out of 2 billion people who depended on wood for fuel mostly in developing countries, only 96 million were able to satisfy their minimum energy needs for cooking and heating through importations and exportations of charcoal.

The FAO has estimated that for the world as a whole total charcoal production in 2009 was 47million tones and increased by 9% since 2004. Africa accounted for an overwhelming share of world's charcoal production (about 63% of global production) in the 2004. Ethiopia is among the leading producer (8%) in the world production of charcoal following Brazil (11%). FAO report also put Ethiopia among the five top world's wood fuel producing country in the period 2004-2009 only next to India(16%), China (11%) and Brazil (7%) in that order. Ethiopia according to the report had 4th rank in its share to global wood fuel production contributing about 5% in the covered period. Fuel wood is preferable energy source for industrial heating in small and medium scale industries (e.g. soap industry). Charcoal is also utilized by small cottage and craft industries (Dawit, 2012).

Table 2.FAO Projections of Fuel wood Consumption to 2030 in the main Developing Regions

Years	1970	1980	1990	2000	2010	2020	2030
Firewood (million cubic meters)							
South Asia	234.5	286.6	336.4	359.9	372.5	361.5	338.6
Southeast Asia	294.6	263.1	221.7	178.0	139.1	107.5	81.3
East Asia	293.4	311.4	282.5	224.3	186.3	155.4	127.1
Africa	261.1	305.1	364.6	440.0	485.7	526.0	544.8
South America	88.6	92.0	96.4	100.2	107.1	114.9	122.0
South Asia	234.5	286.6	336.4	359.9	372.5	361.5	338.6
Charcoal (million tons)							
South Asia	1.3	1.6	1.9	2.1	2.2	2.4	2.5
Southeast Asia	0.8	1.2	1.4	1.6	1.9	2.1	2.3
East Asia	2.1	2.3	2.3	2.2	2.1	2.0	1.8
Africa	8.1	11.0	16.1	23.0	30.2	38.4	46.1
South America	7.2	9.0	12.1	14.4	16.7	18.6	20.0

Source: Broadhead *et al.* (2001)

In 2001 the FAO began a significant effort to reassess their projections of fuel wood consumption. The FAO study shows a growing consumption of fuel wood worldwide, particularly in Africa (Broadhead *et al.*, 2001). According to the FAO (2000) the quantities of charcoal needed by 2020 and 2030 in Africa alone is estimated at 38.4 and 46.1 million tons respectively (See Table 2). This shows that charcoal will continue to be a key source of household's domestic and commercial cooking energy form for most rural families in the developing world. The overall quantities involved, and the numbers still relying on fuel wood will continue to be very large.

The International Energy Agency (IEA) (2001) also estimated that in 2030, biomass energy will still account for an estimated three quarters of total residential energy in Africa. Additionally, due to population growth, the number of people using fuel wood and other biomass fuel demand will rise by more than 40 percent during 2000–2030 to about 700

million. In Asia, despite declining consumption, there will still be an estimated1.7 billion users in 2030, while 70 million would be in Latin America.

Barnes *et al.* (2002) estimates that charcoal consumption is often growing faster than firewood consumption. Charcoal is becoming a much larger part of the fuel wood total in Africa and South America and, growing close to the rate of population growth. Significant variations between countries exist, but the general trend of decreasing per capita consumption of both fuel wood and charcoal with increasing income remains.

There is a kind of ladder of energy sources in the urban areas: from firewood at the bottom, through charcoal, kerosene and LPG, to electricity at the top (Kammen and Lew, 2005). People generally climb this ladder as their income increases. Therefore charcoal, which is infrequently used in the rural areas because of availability of free wood, is quite popular in urban areas because of higher income and other factors such as its lightness and non-smoking nature (FAO, 2000).

As income rises, initially more fuel wood is consumed, but beyond a certain level its use decreases due to its substitution by other fuels (Kammen and Lew, 2005). According to Filmer and Pritchett (2001) price influences the amount of fuel that is consumed, but only minimally affects the choice between fuels.

Growing urban populations are relying on the more compact charcoal as the primary source of urban cooking energy (Kammen and Lew, 2005), with many transitioning from firewood to charcoal as the cost of wood increases in urban areas (Barnes *et al.*, 2002).

2.4 Environmental and socio-economic Impacts of Charcoal Production

Charcoal industry has been viewed negatively because it is associated, rightly, with deforestation and land degradation, slow and unsustainable growth of trees, wasteful use of wood, environmental pollution and poor working conditions of those involved in production (Mugo and Ong 2006). Charcoal production is inevitably followed by associated environmental problems such as the depletion of preferred species, forcing producers to resort to lesser-used species and, critically for livelihoods, food-bearing trees. Where charcoal is produced in quantity, localised deforestation has been noted (Davison *et al.*, 2013).

Although deforestation on a large scale predicted in the 1970s wood fuel crisis proved unfounded, localised examples in vulnerable forests were recorded (FAO 2005; Kituyi, 2004; Girard, 2002). As the demand for wood fuels, increase in these areas the marginal value of tree resources increases, fuelling unsustainable exploitation due to increased profit margins (Luoga *et al.*, 2000). In this way preferred trees species for wood fuel become increasingly scarce, and alternative species are substituted to meet the growing demand. This process can lead to changes in the species composition of forests and have significant consequences for the environmental services that forests provide (Frost, 1996; IGBP, 1995). One of these services afforded by forests is the regulation of the world's climate through carbon storage and sequestration (IPCC, 2001). Continued deforestation linked to the exploitation of wood fuel s is likely to affect this potential, firstly through the reduced storage capacity of forests and their potential to sequester carbon, and secondly because both the production process and the end use consumption of wood fuels are significant sources of GHGs (Richard, 2007).

Removal of woody biomass for fuel poses some far-reaching consequences on the structure and functioning of ecosystems worldwide. Fuel wood extraction has been cited for increasing soil erosion, reducing soil moisture content and decreasing soil fertility as nutrient leaching is increased (Angelsen and Kaimowitz, 1999). Vegetative cover and subsoil nutrients are also fast declining through the charcoal activities. These are then associated with more extensive effects including reservoir siltation, flooding, water shortages due to shifting ground water regimes (Oguntunde*et al.*, 2008) and biological impacts such as reduced faunal abundance (Ogunkunle and Oladele, 2004) and biodiversity. Additionally, in extreme

cases such changes are expected to culminate in changes in weather patterns and, in drier regions, desertification (Angelsen and Kaimowitz, 1999), thus making the increased utilization of fuel wood by urban populations one of the most critical environmental issues sub-Saharan Africa must address (Stephen, 2011).

The subtler impacts of tree cutting for fuel wood are much more relevant when discussing the ecological impact of cutting. The most important perhaps is change in species compositions as cutting influences the survival and reproduction of preferred fuel species relative to less preferred species. A study done in Nigeria, Burkina Faso, Mali, Niger and Senegal found substantially different species compositions in farmed parkland and a nearby ecologically equivalent forest reserves (Stephen, 2011).

Tree species, which do not coppice, may disappear altogether. A study in Senegal noted that many tree species, particularly large trees have very few seedlings and therefore very low probabilities of regenerating naturally (Lykke, 1998). Another study in Ghana found that an important fuel wood species such as mahogany used by 80 percent of households in two villages in the savannah belt during the past decade was no longer available (Pabi and Morgan, 2002 cited in Stephen, 2011).

In addition to the environmental consequences, there are also social and gender implications related to wood fuel consumption (UNDP, 2005). Shortages of wood fuels for subsistence users are becoming more pronounced, particularly for the landless poor due to deforestation, as well as reduced access to forests driven by the privatisation of resources (Arnold and Persson, 2005). These actions reduce the livelihood potential for subsistence users dependent upon forests who must seek alternative means to procure products previously gathered from forests.

This is illustrated in fire wood collection activities where both deforestation and privatisation of land increases the time spent searching for firewood, preventing women and children from other more productive activities (UNDP, 2005). There are also significant health issues concerning the use of wood fuels where incomplete combustion results in polluted living conditions, significantly reducing the welfare of women. These conditions are directly responsible forthe

death of more than 1.6 million people annually worldwide (400,000 in SSA) due to respiratory diseases (Bailis *et al.*, 2005). This has been predicted to jump to almost 9.8million deaths by 2030 in line with increased us e of wood fuel for energy in developing countries (Richard, 2007).

In spite of the environmental and social impacts of wood fuel production and consumption, the trade plays a significant role in the informal markets of developing countries (WEC, 2004). In Kenya alone, the charcoal trade is worth US$ 400 million per year, which if extrapolated over the whole of Africa would run into a few billion dollars (Mutimba, 2005). In order to supply this demand a large section of rural households are involved in the activity, facilitated by the low entry barriers. As a result, charcoal production is one of the main livelihood components of the rural poor in SSA (SEI, 2002; Kituyi, 2004; Girard, 2002).

For many more, the activity acts as a supplemental source of income, "a safety net" in times of hardship (Arnold and Persson, 2005; FAO, 2005). Mutimba (2005) demonstrated this in Kenya where there were over 200,000 charcoal producers and over half a million people (producers, transporters and vendors) were directly involved in the trade. However, despite being a considerable source of income for millions of people worldwide, charcoal burners receive only a small share of the total revenues compared to the transporters and wholesalers (Ribot, 1997; Mutimba, 2005). Combined with few opportunities in rural areas the low profits associated with the activity is limited in providing sufficient benefits for producers to rise out of poverty (Richard, 2007).Despite its negative image, there is no doubt that charcoal trade will not stop. Instead, it will remain the main and, in some cases, the only source of energy for millions of people in the region for a long time to come (Mugo and Ong, 2006).

2.5 Charcoal utilization pattern in Ethiopia

It is evident that the Ethiopian economy (as most economies) is highly dependent on natural resources. Exploitation of these natural resources may generate large economic benefits in the short term. However, in the long term unsustainable use of these natural resources increases not only environmental degradation, but decreases economic growth and livelihood opportunities (Cesar and Ekbom, 2013).

Heavy skewedness of Ethiopia's energy consumption towards biomass resources is attributed to deprivation of access, deep rooted poverty, technological backwardness, and numerous other factors. International Energy Agency report evidenced the unhealthy reliance of Ethiopian economy on biomass fuel resources for national energy requirement which has caused multifarious puzzles. According to the report, in the year 2008 alone 92% of Ethiopia's energy demand was met from biomass source. Hydro power and oil products claimed mainly 1% and 7%respectively. These shows the extent to which national energy balance of the county is resilient on biomass resources (Dawit, 2012).

Only about one household in every four (23%) has electricity, with a very large disparity between urban and rural households (85% versus 5%. Due to the lack of electricity, other energy sources such as wood, charcoal, dung and crop are used for cooking and heating. Urban populations are growing and although an enormous effort has been put into the provision of housing and basic services and improving slum areas, further efforts are required due to increasing demand. There is a need to improve urban land management, the implementation of solid waste disposal and water -borne sewage disposal systems (Cesar and Ekbom, 2013). This also indicated that economic costs of environmental degradation on poor are clear, as the poor are unable to protect themselves adequately against environmental hazards, such as drought, afford to take sufficient remedial actions, to engage in alternative livelihoods, which can protect them from the environmental risks, or to provide themselves with alternative sources of income and employment.

Trend and share of different biomass fuel sorts in total biomass consumption for the last decade was presented below. Firewood was the major biomass type consumed in Ethiopia. The

country is the number one producer in its share to world's charcoal and woody fuel wood as compared to other African countries. Evidences indicate that 99% of households, 70% of industries and 94% of service enterprises use biomass as energy source. Trend in total biomass consumption different sectors implies that households consumed almost all biomass fuels in the last decade. Computed average share of household biomass fuel consumption out of total biomass consumption as fuel over the 11 years stood at about 99.6% (Dawit, 2012).In Ethiopia, a wood energy survey of 1996/ 97 indicates that 230,000 tonnes of charcoal are used every year. Seventy per cent of the total production is used in towns, supplying 97% of household energy needs (Mugo and Ong, 2006).

2.6 Charcoal production in relation to prosopis

It has turned large hot dry plains green in the last 30 years – but still it is a major scourge that goes largely unattended: mesquite or under its official botanical name *Prosopis juliflora*. In the last thirty years this hardy well rooted shrub made its way from Latin America to all parts of the world, covering millions of hectares in for instance India, Pakistan, Yemen, Sudan, Somalia or Ethiopia. In many places it was first introduced in sand dune stabilization projects. However prosopis has the habit to 'overstay its welcome' and expand rapidly and not go away. The area estimated conquered by the invasive species in the last ten years in India, Pakistan, Yemen, Kenya, Sudan and Ethiopia is way above 10 million hectares (Mugo and Ong, 2006).

Particularly in areas where there is livestock grazing prosopis spreads rapidly: the seedpods cling to the animals and are distributed widely. Prosopis germinates easily and once it has settled in an area it is difficult to get rid of it. It takes over the natural vegetation, does not allow undergrowth and hence greatly reduces the grazing value. It also tends to creep into waterways -including dry riverbeds- choking them in the process and causing rivers flood to run wild. The prosopis thorns are poisonous and can even cause blindness (Mugo and Ong, 2006).

Prosopis is not only a scourge. It also has some benefits to its credit. Particularly when the plants are not too craggy (as happens in the more arid areas) the wood can be used for charcoal or even timber. The pods attract bees and have high sugar content – they can serve as animal feed or be processed even into a sweetener. Prosopis juliflora can be used to improve the worst – saline or

alkaline soils. Particularly, when some of its charcoal is added as biochar, degraded soils get a boost (Mugo and Ong, 2006).

On balance however it is a scourge that is steadily undermining the livelihoods of large populations in some of the most vulnerable dry agricultural and pastoralist areas. By now there are several attempts to control 'the mesquite tide' with mixed results. In Afar in Ethiopia the production of charcoal from prosopis was very much encouraging. The problem however is that the prosopis charcoal is inferior to the one from acacia for instance. Instead of prosopis charcoal the acacia was widely processed – accelerating the degradation of the common land. A total ban on charcoal trading was hence re-invoked in several parts of this region (Mehari *et al.*, 2013).

Charcoal production in Afar lowlands of Ethiopia

Farm Africa has worked on eradicating prosopis in a number of ways. First is to uproot the plants and then very rapidly convert the area in an agricultural area or into a well-managed grazing area so as not to allow a comeback. Secondly, encouraging regulated production of charcoal through a number of co-operatives. Thirdly is to systematically collect the pods and crush them into animal feed - making sure they do not germinate but are turned into an economic asset.

In Sudan mechanical and manual uprooting of prosopis has been promoted. The challenge is not the uprooting as such but to ensure the plant does not make a quick comeback. In one of the irrigation systems an all-out ban on livestock was introduced after the area was cleared. This helped to keep the area 'clean'. Similarly in the Gash system in Sudan land was given to farmers on the condition that it would be taken back if they could not control the emergence of prosopis.

These are all good openings – but far more needs to be done. In the assessment of the Afar eradication program for instance the area under prosopis expands more than 20 times faster than the area that is brought under productive use. Also menaces such as prosopis have not had much attention from research and development community – and this would need to be changed too (Mehari *et al.*, 2013).

2.8. Conceptual Framework

Charcoal production is inevitably followed by associated environmental problems such as the depletion of preferred species, forcing producers to resort to lesser-used species and, critically for livelihoods, food-bearing trees. Where charcoal is produced in quantity, localized deforestation has been noted (Davison *et al.*, 2013). The charcoal production and agriculture contribute to woodland degradation and deforestation in Ethiopia. The major reasons for deforestation in the country are the clearing of forests and woodlands for cultivating crops and the cutting of trees and shrubs for various purposes, notably for fuel wood, charcoal, construction materials, etc (Abebe and Endalkachew, 2011).

More importantly, Charcoal production has far-reaching impacts extending across a range of social and environmental issues. These include health problems of charcoal producers associated with air pollution, environmental change associated with greenhouse gas emissions and the depletion of local forests and woodlands, and social problems related to migration, labor and gender (BTG, 2010).

The people of the study area use *Prosopis juliflora* as a fuel wood and for other many purposes. Afar Region, especially Gewane *Wereda*, produced huge amount of charcoal and transported and sold towards many parts of the country and gain benefits. Charcoal production in Gewane *wereda* may affect the social and economic statuses of the communities involved in it. Besides, it may have far reaching impacts in depleting the ecology (indigenous tree species) of the study area. Though charcoal production has a combination of the aforementioned impacts, this study given due attention to the investigation of the socio-economic effects of charcoal production.

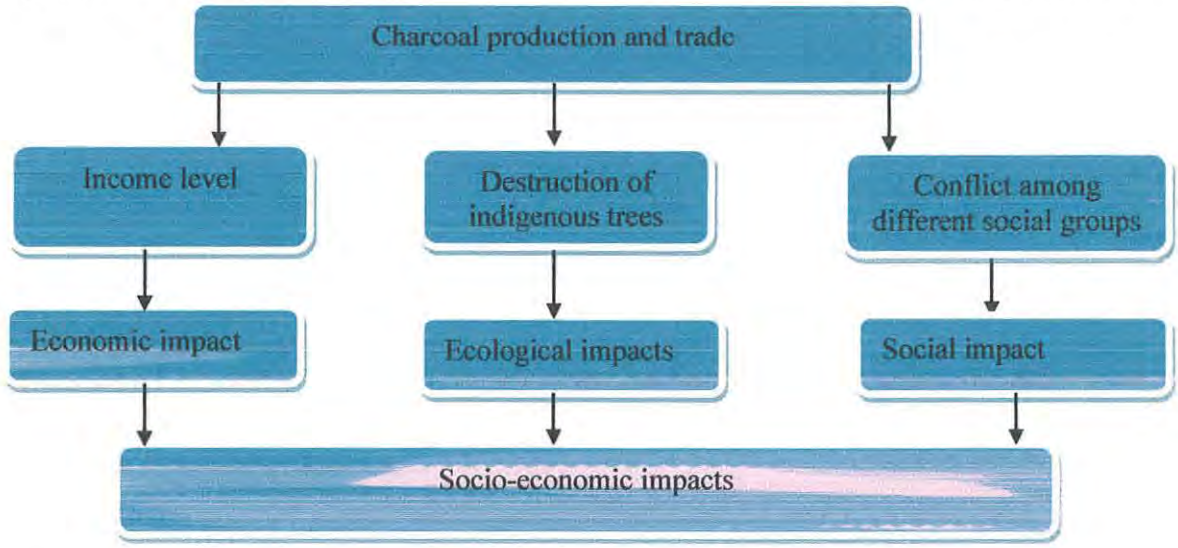


Figure 1.Conceptual framework

Source: Own Formulation, 2014

CHAPTER THREE

3 METHODOLOGY

3.1 Description of the study Area

3.1.1 Location

Gewane *Wereda* is located in the Middle Awash Valley; Zone III of the Afar National Regional state (Figure 2). Fromthe total area of Zone III of the Afar national Regional State 1,680,057 hectares, Gewane *Wereda* covers 826,573 hectares of land. The *Wereda* constitutes 49.20% of the total land area of Zone III. The Middle Awash Valley (MAV) lies along the Awash River Basin, between the Upper and the Lower Valleys of Awash, where sugarcane and cotton plantation have been established by the central government of Ethiopia.

3.1.2 Climate

The area is characterized by high temperature; it ranges from 25^0c to 35^0c. Usually the mean annual precipitation is less than 600 mm. May/June is the driest season of the year, *'hagay'*. It is said to be unsuitable for browsing since bushes dry up. The main rainy season (*'Karima'*), which accounts for above 60% of the annual total rainfall are from July to September. This is followed by the best grazing season of Kayra that occurs form September to November. Another minor rainy season is Sugum and appears during March and April.

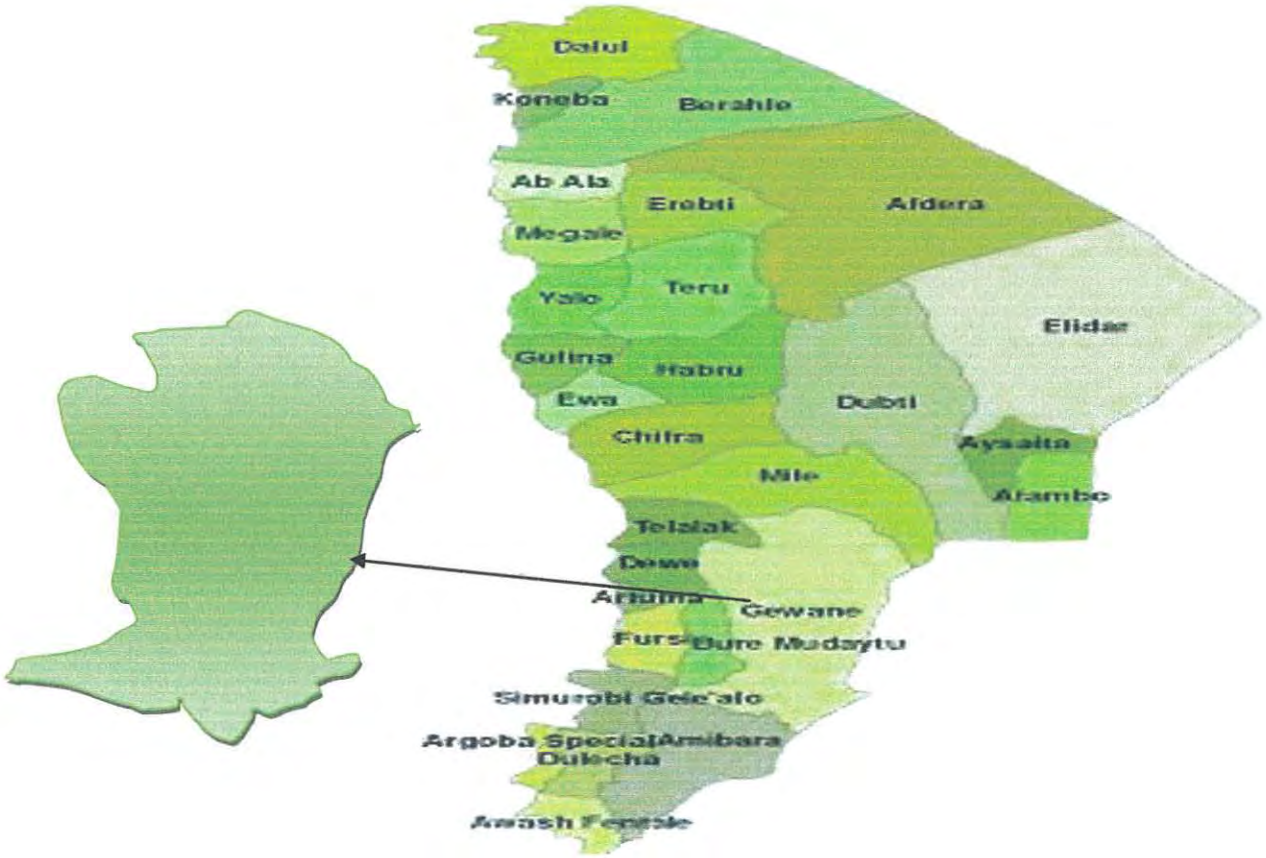


Figure 2. Map of the GewaneWereda, and GalilaDora

The Sugum accounts for 20% of the total rainfall. Gilal is less severe dry season with relatively cool temperatures (November to March). Occasional rainfalls called dada may interrupt Gilal (Yasin, 2004).

3.1.3 Socio-economic activities

Many young Afar both men and women, are absorbed into the urban-based irrigation scheme culture, occupying the lowest skilled activities like watchmen and cleaners. Clan integrity is also beginning to suffer, as the clan is unable to maintain all its members in one place due to the changing nature of pastoral production. While the role of demographic and environmental forces are recognised, political constraints have also contributed to the crisis of Afar pastoralist in the Awash valley. In the end, the Afar has been excluded from the mainstream of Ethiopian development (Ali, 1997; cited in Piguet, 2007).

About three decades ago, the Afar economy based on pastoral movements, supplemented to a very limited extent by trade, was still a viable economy, until the 1973-74 drought and famine designated as Jahum (the famine which throws out people or forces them to migrate), followed ten years later by the Sabasabat famine. Using the foothills for wet season grazing and the riverside of the Awash for the driest season, the Afar had managed to produce a viable economy. Viability was also maintained by the traditional production system, which had built-in survival strategies and supplementary and alternative production activities for the tiny minority sloughed off from the pastoral production system (Piguet, 2007).

Thus, the livelihood of Afar is mainly depending on raising cattle, camels, goats and sheep. They are highly dependent on the natural resources such as rangeland, water, trees and minerals. Their system of adaptation is highly responsive to seasonal variation in rainfall and range. They may move from one area to another in search of grass and water. Mobility is necessary to ensure an optimum exploitation of their environment.

3.1.4 Vegetation type and Cover

Vegetation type of Afar region is composed of woods or bushes found along the major perennial rivers, mainly the Awash River cover a total area of 145,000 hectares, which is about 1.58% of the total regional area. Gewane *Wereda* constitutes 63,771 hectares, which is about 43% of the total reverine woodland or bush land cover. The vegetation in this *Wereda* is evergreen due to continuous water supply from the Awash River and is browsed by the livestock (camels and goats) during the dry season(Yassin, 2004).In addition, land coverage of Gewane *Wereda* includes open shrub land, which comprised of both shrubs and herbs (grasses) with low density.

3.1.5 Population Density

The Afar region is among the areas of the country with low population density (13 persons per km^2) with population size of 1,106,383 and land area of 85, 410 km^2. /According to the 1996 census/, the region has a population density of 13 persons per km^2. Particularly, GewaneWereda is the least densely populated Wereda in the region, which is 3.5 persons per km^2 (Yassin, 2004).However, it is important to put in mind that the population density among

Wereda might vary from time to time as the result of seasonal movement pattern of the pastoralists depending upon the availability of grazing land and water points.

3.2 Sampling technique and sample size

This study was planned and executed using both qualitative and quantitative approaches. The study site, Gewane *Wereda*, Galila Dora kebele was selected purposefully. This kebele Administration (KA) is known in production of charcoal from both Prosopis and indigenous trees. In addition the livelihood of local people partly depends on charcoal production.

Head of households (HHs) who actively engage in charcoal production were listed through discussion with key informants and local elders. About 114HHs who were actively engaged in charcoal production were identified. However, since the number of charcoal producer is small in size, it was decided to take all charcoal producers HHs in the study. Nevertheless, out of the total charcoal producers in the Galila Dora KA only100 voluntary HHs were obtained. While the rest 11 and 3 heads of households were not willing and not found during data collection, respectively. Thus, number of sample respondents was limited to 100 HHs. Even though, the settlement pattern in the study KA is not in an organized manner this study coverall charcoal producers so as to get the real picture about the problem under investigation.

Moreover, with the aim of getting detailed information about the socio-economic effects of charcoal production in the study area, Focus Group Discussion was conducted. Hence, eleven members of FGD were purposely selected from charcoal producers, clan leaders and local community leaders to collect specific qualitative information regarding charcoal production and its impact.

3.3 Data sources and Methods of data collection

The study was conducted in the Galila Dora Kebele of Gewane *Wereda*. The study employed both primary and secondary data. The primary data were collected using a number of data collection tools such as household survey, interview with local elderly, clan leaders, government official responsible in the areas of this study, FGD, direct field observation, etc.

FGD involved members from charcoal producers, experts from regional and *Wereda* and senior agricultural bureau and the session was ranged from 6-12 members with two rounds.

The primary data were collected through face-to-face interview with head of the household using interview schedule by going to each interviewee's residence and each respondent was informed about the purpose of the survey before starting the interview. Enumerators were recruited locally based on ability of local language, knowledge and experience and were trained on the content of questionnaire, methods of data collection and approaching agro-pastoralists during interview. The interview schedule was pre-tested on eight randomly selected farm household heads before conducting the formal survey.

On the other hand, secondary data were also collected from document reviews and documented data from the respective offices.

3.4 Methods of data analysis

Information obtained from field observation, through an interview made with elderly and clan leaders, and focus group discussions were analyzed qualitatively. Whereas some of the information obtained by employing questionnaire was analyzed using simple descriptive statistics methods such as frequency distribution, percentage, figures, pie chart, and cross tabulations.

3.5 Ethical Considerations

At the very beginning, letter of recommendation was written by Center for Environment and Development, Addis Ababa University. Following the letter, Afar Regional State Bureau of Agriculture approved the recommendation letter to the Gewane *Wereda* Administration which in turn paved the way for the researcher to go to Galila Dora *Kebele* of the *Wereda.* The researcher had recruited four enumerators and one supervisor for the data collection process. The enumerators were trained for two days on the research procedures and ethical issues. They were told to inform the respondents that their response will be kept confidential and used only for academic purposes. Finally, the respondents' right not to respond for any specific question(s), to stop the interview at any time and stage, and the right not to involve in the research at all was ensure by the researcher as important ethical considerations.

CHAPTER FOUR

4 RESULTS AND DISCUSSIONS

4.1 Demographic Characteristics of the Respondents

Table 3.Age and sex characteristics of respondents

Sex	Count	%
Male	93	93
Female	7	7
Marital status	Count	%
Married	63	63
Single	31	31
Divorced	6	6
Age group	Count	%
10-25	11	11
26-41	74	74
Above 42	15	15
Education level	Count	%
Illiterate	43	43
Primary	26	26
High school	24	24
College	7	7

Source: Own Survey, 2014

Table 3 depicted that 93% of the sample respondents were male and 7% of them were female. This can be attributed to their active involvement of in the sector of charcoal making and trading. Majority of charcoal worker and owner are male in the study area. This indicates that women have no more participation in the charcoal business.

In addition to this, with regards to age of respondents, most of them i.e. about 74% were found within the age range of 26-41, followed by those above 42 i.e. 15%. The least were found with in age range of between 10 and 15. Furthermore, about 63% respondents were married while the rest 31% and 6% were single and divorced, respectively.

In addition to this, respondents educational background were distributed in such a way that around 43% were illiterate while the remaining 26%, 24% and 7% of the respondents were primary, high school and college complete, respectively. This shows that significant number of the people involved in charcoal production belonged is illiterate.

4.2 Charcoal Production Processes and trading

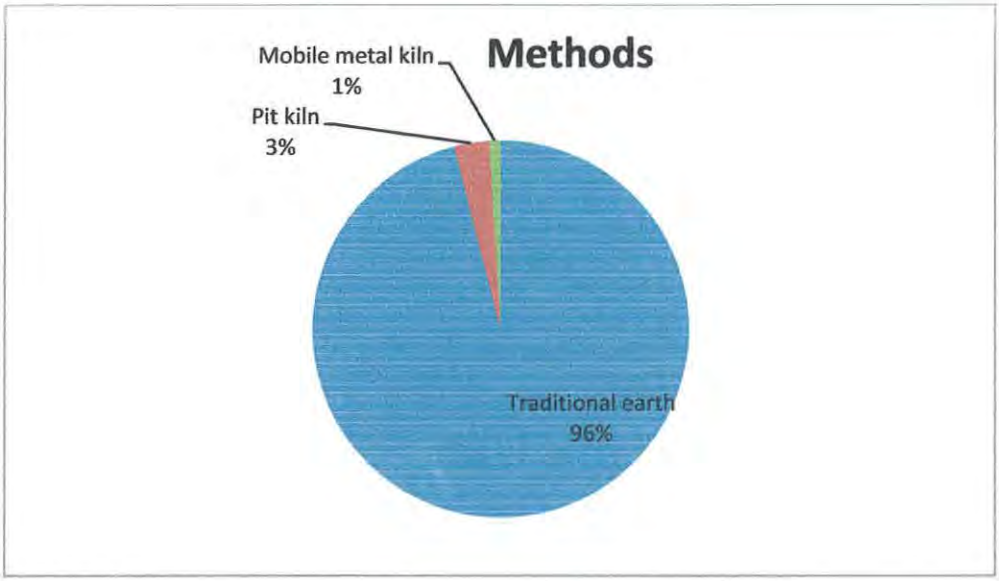
The vast majorities (96 percent) of charcoal producers in the study area use the traditional/earth mound method of charcoal production (Figure 3). Charcoal is produced through a series of traditional methods and processes. The processes of charcoal production that charcoal producer follow are outlined below:

1. Charcoal production process often commences with the selection of location where the trees found in abundance.
2. The identified trees are then cut and harvested over a period of time for free. Some of the selected woodlands are communal lands of the clan.
3. the cut wood are sorted by diameter and stacked next to the burning site (Photograph 1)
4. The wood is then stacked into a dug-out earth pit or heap on a relatively flat plain up to a reasonable height and covered with a layer of grass/ leaves and sand (photograph 2). A heap of sand is then gently used to cover the entire heap. They leave two very small openings for fire to be lit and smoke exit. Several amounts of top soil and shrubs are needed to cover a single heap.
5. The fire is then lit from the opening. After the entire woods/logs catch fire the hole is sealed with small sticks and grasses.
6. The process is then closely monitored both day and night for about 10-15 days, depending on the size and moisture content of the wood during carbonizing. Gradually the logs burn into the required charcoal. During the process, a series of events are created in each earth mound. This is done to allow proper ventilation and continued burning for

up to one or two week depending on the size of the woods and the heap. If the earth kiln is not vented properly, it can either smother the fire before carbonization takes place or burn too hot, causing over burning, leaving only a pile of ashes. The process of carbonizing is completed when it stops smoking and cools.

7. After completion of carbonization, the charcoal worker begins separating the dirt and debris and grading the newly formed charcoal. About 2-4 days are spent in this process, depending on the size of the laborer available. The charcoal is then collected into bags and delivered to charcoal owner then it is ready for market.
8. Finally, selling to end user or middle men.

Figure 3.Methods used during charcoal production



Source: Own Survey, 2014

It is clearly shown in figure 3 that majority of the surveyed households reported they are using the traditional/earth mound method of charcoal production (96%) followed by pit kiln (3%) and mobile metal kiln (1%). Those who were using mobile metal were the a few number of associations organized by the support of Farm Africa.

Figure 4 sorted woods for charcoal production

Source: Own field photo. 2014

Figure 5: Photograph of earth mount method of charcoal production being used

The earth mound method of charcoal production causes damage to the vegetation. As observed from major charcoal producing sites in the study area, this process has several weaknesses. These weaknesses contribute immensely to the degradation of the natural environment. Traditional method of charcoal making could trigger bushfires through the vents and other openings. Some producers also pointed out that in cases where producers mishandled the fires, bush fires easily took place and destroying vegetation. This method may also cause damage to a lot of fauna and flora. Apart from cutting trees for charcoal production, the researcher also observed that forbs and herbs are at risk during charcoal processing. The process usually damages the surface of the top soil and shrubs, as a result of digging and burning during the production cycle. Moreover, the result of focus group discussion confirmed that the mound areas will not re-vegetate for several years even as rain drenches.

It was observed that young trees were devastated, landscape full of burned stumps, cut branches, abandoned logs, and vehicle trucks crossing large trucks of land. The excessive depletion of the trees is apparent and poses threats of serious environmental consequences in the area, as the main sources of wood supply is the fragile natural forest. The researcher observed that there as assign of environmental degradation and massive deforestation of indigenous trees in the area.

Table 4.The main user of produced charcoal from the study area

Users/consumers of charcoal	Response	Frequency	Percent
Hotels	Yes	38	38.0
	No	62	62.0
Restaurants	Yes	15	15.0
	No	85	85.0
Communities or users outside Afar	Yes	84	84.0
	No	16	16.0

Source: Own Survey, 2014

In the survey question, respondents were asked who is/are the main purchaser of their charcoal. They replied that the customers' are hotel and restaurants reflect end users of the product as well as 'walking drivers' and 'communities outside afar' refers to recipients of charcoal within Afar for the purpose of transferring it out the end consumers especially outside the region (see Table 4). This is true, because charcoal is needed in many places and there for, they make lucrative incomes out of it.

Thus, walking drivers are the highest recipient of charcoals sold along roadsides compared to the others. This happens as the drivers are always using cars of different types, it is simpler for them to keep some sacks of charcoal so ›where in their car or use the car to transfer it to other place from its area of production and/or ›l market places.

Table 5.Challenges of Charcoal producers

Type of challenges	Response	Frequency	Percent
Charcoal gets wet	Yes	100	100
during rainy season	No	0	0
Attack of wild	Yes	53	53.0
animals inside forest	No	47	47
Conflict with local	Yes	35	35
community	No	63	63
	Missing	2	2%

Source: Own Survey, 2014

All respondents confirmed that rainfall during rainy season is one of bottlenecks in charcoal production (Table 5). Charcoal production is associated with fire and rain is its enemy. In the study area rainy season is a time that yield of charcoal is significantly reduced and thereby incomes from charcoal marketing minimized.

Wildlife is also another source of challenge that affects the production of charcoal in full capacity. Lions, snakes, pythons, etc are sources of physical insecurity for the workers directly involved in the production of charcoal. At the same conflicts arise between charcoal owners and migrant workers. This result in reduction of charcoal yield until the dispute is resolved.

Conflict of interests arising among local communities for charcoal production often occurs when two or more local clans or tribes have property ownership over the resources. In Afar, conflict of this type is so serious and often resulted in widespread physical attacks leading to losses of human life and property. This situation is more serious than other causes of conflicts. In general, these factors are considered as 'undesired' by the charcoal owners as it negatively affects potential household income until these are properly managed. The source of challenge that affects household incomes from the production and sale of charcoal is related to external factors. These are presented in the Table 6.

Factors affecting charcoal price

Table 6: Factors that determine price of charcoal

Price is affected most by	Frequency	Percent
Market demands	5	5.0
Market supply	28	28.0
Seasonal variation	52	52.0
Other	15	15.0
Total	100	100

Source: Computed from survey data, 2014

Table 6 showed that some the external factors that negatively affect charcoal business owners' income. As depicted in the Table 6, seasonal variation/ summer and winter affect price of charcoal. In this regard, summer [rainy season] is appropriate to make more profits from the sale of charcoal because price per a suck is rise. This is associated with the cool season and increased charcoal demand in many parts of the country. Winter season is appropriate time to produce charcoals in abundance but market demand is slow as winter in Ethiopia is the warmest season. This time it is needed mostly for cooking and to some extent to keep home temperature warm at night.

Respondents' knowledge about effect of charcoal making on forest and environmental pollution

An attempt was also made to understand the knowledge regarding the negative outcomes of charcoal burning on forest resources and local environmental pollution. The compiled survey result shows that more than 63% of the respondents were well aware of the negative impacts of charcoal burning (Table 7).

Table 7.Perception of charcoal producers regarding forest reduction and environmental pollution

Perception of charcoal producer	Response	Frequency	Percent
Could cause negative impacts on forest	Yes	63	63.0
	No	34	34.0
	Missing	3	3
charcoal production reduce forest cover	Yes	42	42.0
	No	55	55.0
	Missing	3	3
Led to environmental pollution	Yes	60	60.0
	No	37	37.0
	Missing	3	3

Source: Computed from survey data, 2014

They were also asked if they have an intention to stop forest/bush burning for charcoal. In this regard, 55% of respondents were not prepared to stop engagement in charcoal preparation as charcoal has become sources of most favored alternative. Of the total respondents, a good number of the respondents do not know the negative effects of charcoal burning on forest resources and quality of local environment. This shows the urgency on the part of the regional governments to take measures that includes awareness creation about the impact of deforestation. It is also important for the local governments to get into commitments in convincing communities in the study areas to make appropriate decisions in the selection of the tree types they use. At the same time, applying legal procedures on those who fail to obey the rules especially on those who hunt for indigenous trees.

In order to get clear picture and draw conclusions, respondents were also asked specific questions on the level of their knowledge (Table 7). The result indicates that the majority of them knew that, charcoal burning affects environment than forest. In this respect, 60% of the sampled respondents replied that charcoal affects local environment. The result of FGD confirmed that it is the smoke released during the charcoal preparation, which is the prime cause of environmental pollution. Moreover, more half about 55%of the respondents does not aware about the direct effects of charcoal making on the forest resources. Equally, around 37% of the respondents either do not know or have limited knowledge on the negative impacts of charcoal burning on the quality of local environments (Table 7). For these people smoke released from charcoal burning site is normal and has no effect on anything else. These indicate the need to

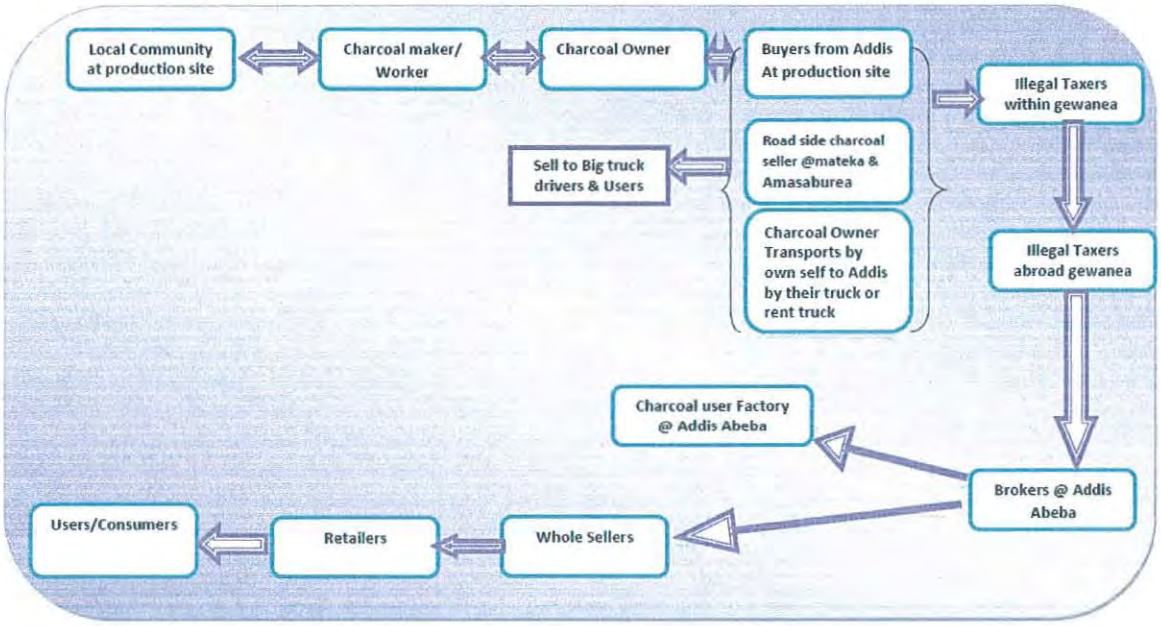
invest time and energy in building the capacity and knowledge level of these people with regard to effects of charcoal production.

4.3 Impacts of Charcoal Production on Livelihoods of Agro-pastoralist

4.3.1 Major Actors involved in Charcoal business market chain

Local community, charcoal owner and or trader and charcoal maker are the major actors involved in charcoal trade in the *Wereda*. These key actors are discussed below in detail.

Figure 6. Key actors in charcoal production and marketing



Source: Own Formulation, 2014

Local community

These groups of actors are local Afar Pastoral/Agro-pastoral peoples who are live in the area of charcoal production site. The representatives of local communities are responsible to the security matters of the charcoal makers. After production of charcoal they get 300 ETB per one charcoal maker (worker) for example if someone charcoal owner employs 10 charcoal makers, he is liable to pay 3000 ETB local communities.

Charcoal Maker

These groups of actors are peoples from neighboring highland part of the country like SNNP, Oromia and Amhara Regions. Their major role in the charcoal market chain is producing charcoal from initial stage to final stage of production. Their remuneration is 20 ETB per a suck of charcoal, from the charcoal owner.

Charcoal owner and or trader

Charcoal owners are the major actors in the chain, their duty encompasses hair charcoal makers, making agreement with local community for the production and security of his employees' or charcoal maker. He bears all risks involved in charcoal production and trade. they sell charcoal to Addis Ababa receiver at production site or road side charcoal seller in Mateeka or they have rent Isuzu truck go to market area them self or they have their own Isuzu truck to use as transportation to go final destination area of market(Addis Ababa).

4.3.1 Contribution to the expenditure and income of the people

Charcoal business in general is contributing a lot to the well-being of those communities involved in that business in the study area. The benefit can be explained in terms of its contribution to saving household expenditure, children school expense, medical and related expenses such as covering the expense for buying chat. Charcoal business gives benefit to those who are engaged in the activity.

Table 8.Contribution of charcoal to the expenditure and income of local community

Welfare Contribution	Size	%
For household expenditure	38	38
Children school expenditure	16	16
Covering chat expense	34	34
Medical expenditure	12	12

Source: Own Survey (2014)

Accordingly, about 38% of the selected respondents reported that they use charcoal profit for household expenses. Those who are addicted to chat (34%) use the gains mostly to cover chat expenses. School expense and medical expense constitute 16% and 12%, respectively (Table 8).

As depicted in Table 9 about 36% of the respondents kept their money saved in the bank. On the other hand 26% of them bought an ISUZU truck that used to do business by transporting charcoal produced in the *Wereda* (see figure 7).

On the other hand a significant numbers of the local communities managed to construct modern housing units so that they are leading better lifestyles with their family. Figure 7 below shows sample fixed assets owned by some of the local people involved in the charcoal business. So it is very easy to understand how the livelihoods of these people have been improving at the costs of indigenous trees loses.

Table 9. Mechanisms of handling profit from charcoal business

Handling of profit	Size	%
Bank	36	36.0
Buying transportation vehicle (like Isuzu, etc.)	26	26.0
Constructing modern house	43	43.0
Total	100	100.0

Source: Own Survey, 2014

As depicted in table 9, majority of the sample respondents (43%) reported that they kept their profit gained from charcoal business through constructing modern houses where as 36% and 26% of the surveyed respondents reported they kept the profit earned from charcoal in bank and buying vehicles respectively. This shows that charcoal business is improving the livelihood of those individuals involved in it.

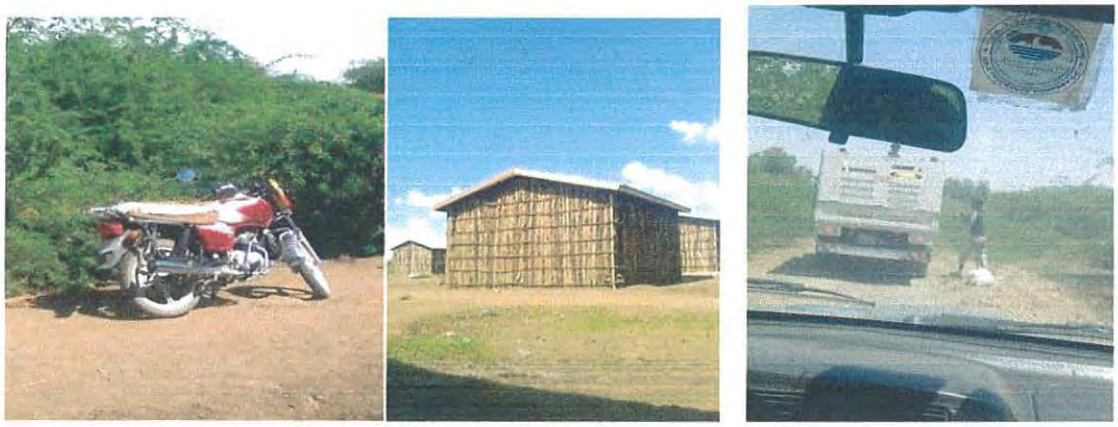


Figure 7: Some of the assets owned by illegal charcoal businesses

Source: Own field photo, 2014

4.4 Social impact of charcoal production in the study area

According to GWARDB (2014) report charcoal business is very hot and current income earning activity for many households of the *Wereda*. It involves different stakeholders from different parts of the country. It was established by farm Africa in 2004/05 as a response to prosopis invasion. It was a legal activity during the time when farm Africa established the first cooperative in Galela dora kebele but currently, its legality is in doubt. Figure 8 shows the location of illegal charcoal production sites in Gewane *Wereda*.

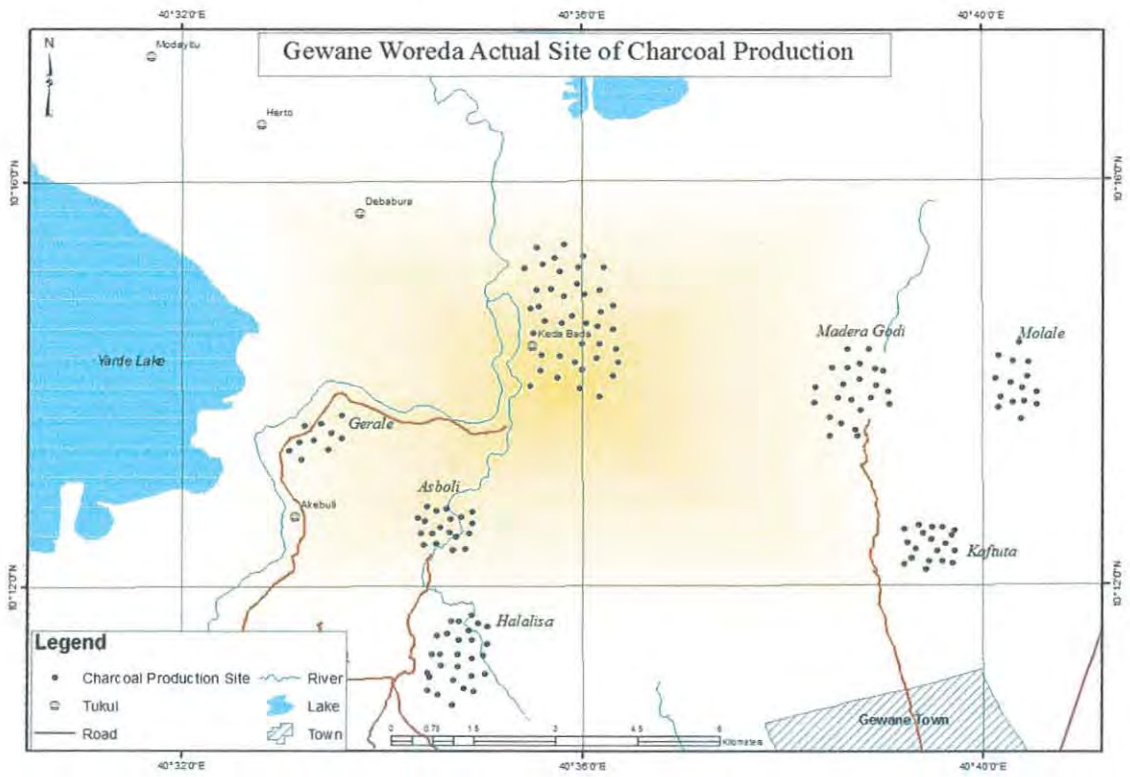


Figure 8.Illegal charcoal production sites in Gewane *Wereda*, Afar

Source: EPA of Afar, 2014

4.4.1 Charcoal production and Conflicts

There were different forms of conflicts among different groups of population in the charcoal business areas. Conflicts in Gewane *Wereda* exist between owners and makers, between different clans, and between charcoal makers and the local/site communities. Majority of the respondents (51%) reported that existing social life is being disturbed by the presence of charcoal driven conflict between charcoal makers (employees) and local communities, which are found around the site (Figure 8). Charcoal makers were mainly highlanders and the local communities were livestock herders. Focus group discussion and key informant interviews clearly indicated that charcoal producer (owner) were mainly afar communities whereas the employees were highlanders. But conflicts also arise between charcoal producer and local communities (who favor livestock herding), because of action of the former to reduce fodder availability for livestock.

Besides, the focus group discussion confirmed that they fear the employees who came from highland disturb their existing strong local culture. Therefore, while they intend to protect their local culture from being mixed with others, conflicts would be happened. But, this conflict is usually accompanied by strong verbal protests from livestock keepers and rarely leads to violent clashes. Elders and village leaders are very skillful in handling such confrontations in a peaceful manner.

Moreover, as explained through FGD additional source of conflict in the study area was disagreement among clan members living within the study area and the semi urban Kebele Administrations (KA). Here, the major reason for the conflict is the movement of charcoal producers to the other neighboring KAs in search of trees for charcoal making. This incident also brings about clan based conflict over scarce natural resources such as forest. This type of conflict is the worst one in terms of the fact that it brings the largest casualty in the charcoal production site. Meanwhile, the discussion also confirmed that conflicts occur between employee and employer when allowance payment delayed. This situation often leads to confrontation and conflict between the charcoal producer and worker; thereby the later tends to burn the charcoal available in the form of deposits. Beside FGD the survey result regarding social impact will be presented in Table 10.

Table 10.Cause of conflict between charcoal owner and worker

Major causes	Response	Frequency	Percent
Communication barrier	Yes	37	37.0
	No	63	63.0
Delay in the payments of allowance for labor	Yes	56	56.0
	No	44	44.0
Delay inputs (cut trees supply) supply due to conflicts	Yes	10	10.0
	No	90	90.0

Source: Own Survey, 2014

Efforts have done to assess if there were records of conflicts either between charcoal owners and producers (employees). The survey results showed that generally there were records, but the causes for the conflict were not uniform. Communication [language] barrier contributed for the disputes to erupt between owners and worker, yet, this is not a major cause as nearly 2/3 of the

respondents replied, communication barrier was not major cause of conflict. Instead, conflict arises predominantly in relation to payments to be made for the migrant workers. In this case, close to 60% approve 'delay in the payment of their allowance' as a dominant cause of conflicts (Table 10).

Surprisingly about 90% of the respondents replied that, raw material supply for charcoal preparation has not been cause for the onset of disputes between owners and workers.

Question was raised for the sampled respondents to identifying the damages types happening following conflicts (Table 11). As it could be seen from the Table 11, there were reports of deaths (8%). Death involves loss of life and this is the most serious problem, which needs to be addressed urgently. Killing someone for any conflict related to charcoal would be considered otherwise revenge in return would cost more losses. Thus, loss of life is a serious issue and the researcher gives much emphasis even more than protecting cutting of trees. Out of the entire respondents about 37% and 29% of the respondents reported that physical and psychological damage, respectively.

Table 11 Damages as a result of conflict

Type of damages caused due to conflicts over charcoal production	Response	Frequency	Percent
Physical damages	Yes	37	37.0
	No	63	63.0
Death cases	Yes	8	8.0
	No	92	92.0
Mental disorder	Yes	29	29.0
	No	71	71.0

Source: Own Survey, 2014

4.5 The agreement between charcoal owner and charcoal maker (laborer)

In first place to start the charcoal business three criteria are expected to be fulfilled. First, charcoal owner need worker or laborers to participate and start charcoal business. When he think about charcoal business he must came with his charcoal laborer from highland area like, Walanchiti, Addis Ababa and from other part of the country. Then after he sends them to forest

area with an Afar men assigned to supervise all activities while preparing charcoal in the forest. The Afar keepers have their own role to keep them. When charcoal owner send them to forest area the worker or employer or charcoal maker have agreement with their employee or charcoal owner. Most of the charcoal owners in Gawane area are Afar agro pastoral people. Finally, charcoal makers and owners do also agree on the benefit sharing agreements that charcoal makers do have 20 birr commission per sack of charcoal he/she produce.

The owners of charcoal are responsible to make ready all necessary material for charcoal maker. The materials are all the materials used to cut tree, chop the branch, dig pit holes where to burn the charcoal. Furthermore, the owner of the charcoal is also mandated to provide the migrant workers basic food stuffs during their stay in the forest. After charcoal preparation the owner reduces from their commission all the money that charcoal makers borrowed in advance while paying final term payment.

Most of means transportation used for transporting charcoal from the area of production to market places are horse carts and Isuzu (figure 9). Horse driven carts are used to transport charcoal from their production site to road sides.

Figure 9: An Isuzu truck and horse cart loaded with charcoal from areas production
Source: Own field photo, 2014

Although, Isuzu`s are also used to transport charcoals from their area of production to market places, Isuzu, is more preferable than others to transport the charcoal to the nearest market places or those at distance far such as Addis. Single Isuzu truck has the capacity to carry or load up to 250– 280sucks of charcoal. Thus, if the employer sells 280 sucks of charcoal, the charcoal maker would expect 20birr per suck. The price of a suck of charcoal at the production site is close to 60 birr. Charcoal owners (local people- Afar) obtains 40 birr suck. The aggregate benefit of the charcoal owner from an Isuzu car would be 40*280= 11,200; while that of charcoal producers would be 20 birr*280=5600 birr. This is the revenue or profit of charcoal owners and the employee per one Isuzu. Sometimes this Isuzu truck may load 260 to280 sucks of charcoal. This depends on the condition of supply of processed charcoal.

4.5.1 Nature of agreement between charcoal owner (employer) and local community

The employer sends his worker to forest area for charcoal preparation. The forest is considered as the property of local community living close to the forest sites. Before sending workers to the charcoal preparation site, the workers and employer make an agreement and this will also notified for local community. This agreement is made just for the sake of workers security and to allow to them tree cutting for charcoal making. This agreement is made by two ways these are employing the local community youth as keeper, or giving worker to them to become profitable apparently. The result of focus group discussion with regard to the nature of agreement between charcoal owner and local community is outline as follow.

1. **Employing the local community youth as keeper.** This means in each worker the employer needs keeper. This is creating job opportunity for local community in one hand or alloying them to get worker free of charge (which their salary is played by owner) in other side. The local communities have benefit from the charcoal business as keepers and illegal tax collectors. The entire keeper is employed from the local community. The owner of charcoal has responsibility to pay monthly salary for each keeper. He pays300 to 500 birr to keeper per each charcoal maker. The keepers have daily income in this way. Charcoal owner or the employer may employ15-20 workers or employee. Some owners employ 20-50 workers or more. Charcoal owners locally divide in to three classes based on the number of the workers they employed for charcoal production. These are upper class, middle class and lower class. Usually the lower class and middle class charcoal owner employs 5-20 and20-50workers, respectively. While upper class employed 50 and more workers for charcoal production. The charcoal owners 'weather they are from higher class or lower class they are expected to pay monthly salary for the keeper about 300-500birr per each worker. This agreement is functional when local community member or the keepers agree with this issue. It means when he prefer to get the benefit from the processed charcoal by becoming keeper of the worker. The main activity of keeper is to protect charcoal maker or the employer from local community disturbance and allow to them to cut the tree and make them free in their forest area. Generally this is the 1st way how the local community s' were benefited from charcoal business.

2. **Providing worker to local keeper:** this means the charcoal owner or the employers have to provide some worker to the local community member or directly to the keeper. That means if the charcoal owner has 20 workers he has to provide at least four workers. The cost or all the expense worker or charcoal maker covered by the local community members (keeper). All sucks of charcoal made by four workers belongs to keeper or member of local community. Finally charcoal produced by four workers becomes the salary or benefit of the keeper. in this sense the keeper didn't need money from the owner of charcoal, he simply wait his four workers until they finish processing of charcoal , then he collect his is the property. Generally the keeper has two alternatives to be beneficial from the charcoal business either he wait for monthly salary or he wait for the output worker that has given to him.

Moreover, the local community is also benefitted from charcoal business through illegal tax collection. The illegal tax collectors are doing their business by closing the road by stone and stopping the Isuzu truck that load the charcoal. After the payment is made to an illegal tax collector the truck is allowed to go to the intended area. This is also expected from them when even they get into the territories of other clan. Therefore, for every tax collector who locally responsible to wait and block the road with stones the owner of the charcoal or any responsible person pay to the illegal tax collector 50-200 birr per Isuzu at each gate. In this regard, the researcher has counted illegal tax collectors from illegal charcoal traders close to 22 between Asboli to the main road; I have observed and counted 22 illegal taxing areas. The truck driver must pay for the illegal tax to come and to become free in the road. Generally the charcoal business in Gewane *Wereda* is going based on give and take the principle.

Figure 10: A road blocked with stones by an Illegal tax collector

Source: Own field photo, 2014

4.6 Economic impact of Prosopis related charcoal production and trading

The effects of charcoal production on the economic lives of charcoal producers and motivating force for producers to engage in the charcoal production and trading were identified by assessing in local price at each spot. Market prices were collected five times from each market place in the months of February and March. In order to understand the economic effect charcoal production issues such as average price of charcoal per a suck at different stages such as at market, production site and destination site, as well as revenue earned per a truck (Isuzu) were also examined. Producers also asked to tell their average income charcoal production.

Table 12.Average price of charcoal per 50 kg suck

Market area	Average capacity of truck to load suck of charcoal	Price per suck (Birr)	Total value
Production site	270	60	270*60=16200
Road side	270	80	270*80=21600
Addis Ababa	270	120	270*120=32400

Source: Own survey, 2014

The average loading capacity of an Isuzu truck is 270 suck of charcoal. In addition, an average price per suck was found to be varying across sites. The average price/suck found to be 60, 80 and 120 Birr, at production, road and destination sites, respectively (Table 12).

On the other hand, the total revenue of one Isuzu truck was enormous at area of destination than the production and road side i.e. the average revenue in Addis Ababa was found to be 32400 birr, while the revenue at area of production and road side were found to be 16200 and 21600 birr, respectively(Table 12).

Table 13. Average sale, expenditure and profit of large scale charcoal producers

Market area	Total sale per one Isuzu truck	Expenditure		Income (Net profit)
production site	16200	Labor cost	5400	7200
		Cost for sucks	2400	
		Cost for guard	1200	
		Total	9000	
road side	21600	Labor cost	5400	9600
		Cost for suck	2400	
		Cost for guard	1200	
		Rental of truck	3000	
		Total	12000	
Addis Ababa	32600	Labor cost	5400	13600
		Cost for suck	2400	
		Cost for guard	1200	
		Rental of truck	6000	
		Illegal tax	4000	
		Total	19000	

Source: Own Survey, 2014

As shown in Table 13, with regards to revenues from charcoal production and trading, a total of 16200, 21600, and 32600 Birr revenues were derived from charcoal trading, at production, road and destination sites respectively. Net profit gains by large scale producer and trader found to be 7200, 9600 and 13600 Birr from charcoal production and trade at production, roadside and destination sites, respectively.

4.7 Impact of Charcoal trade on wild life and Indigenous tree

The detailed description of some the indigenous tree species that are highly affected due to widespread charcoal production in many parts of Afar region in general and in the study areas in particular. The lists of their name and their uses were obtained from an inventory made in the field assisted by local elders and clan leaders. The tree species listed in the table are also on the verge of extension due to the colonization of Prosopis tree which spreads rapidly control as much land they could.

Table 14.List of some of the most common indigenous tree species that are highly affected charcoal production

No	Local name	Scientific name	Type	Use or advantages
1	Hamilto		Grass	• It is used as contraction material of Afar traditional house. • Also i used as cows fodder
2	Gadayta		Grass	• Was used especially by women to cover the roof and wall of afar traditional house. • Its root used as food and livestock fodder
3	Hurunto		Grass	• Mostly used as fodder specially for camels
4	Fura		Grass	• It grows under gadeyta tree and it seems like potato. It used as human food and also serve as • Medication to malaria
5	Maderto	Cordiaovalis	Tree	• The leaves used for livestock fodder specially goat and camel • The fruit used as enjoyable fodder for humans
6	Heda	Grewiatenax	Tree	• The leaves used for livestock fodder specially goat and camel • The fruit used as enjoyable fodder for humans
7	Habela		Tree	• Leave used for livestock fodder specially goat and camel • Fruit used as enjoyable food for humans
8	Kasalto	Acasianilotica	Tree	• Used for livestock as fodder • Liquid sticker eaten by human
9	Adgento		Tree	• Hard cover used for tradition tea purpose • Liquid sticker eaten by human
10	Kilayto	Combretumaculeatum	Tree	• Livestock fodder
11	Subla		Tree	• It shade is good and preferable for traditional meeting area • Livestock fodder
12	Udda	Ficusspp	Tree	• Fruits is eaten by human • Liquid sticker us chewing gum • Its leave used as traditional medication purpose
13	Adayto	Salvadorapersica	Tree	• Used for brushing teeth • Root used for traditional medication purpose
14	Rareyta	Cyndondactylon	Grass	• Livestock fodder
15	Sitabu	Vossiacuspidata	grass	• It was used for livestock fodder specially

No	Local name	Scientific name	Type	Use or advantages
				to cows and goats • It was also eaten by humans because it was sweat
16	Fi ayto		Grass	• It was used for livestock fodder specially to cows and goats
17	Arke		Grass	• It was used for livestock fodder specially to cows and goats • Women used for house decoration and traditional perfume

Source: Own Survey, 2014

4.8 Knowledge of Community on Charcoal Production

Out of the total 100 respondents, wide majority of them (93.8%) did not consider all trees in their surrounding as an appropriate and therefore focus on Prosopis and other indigenous trees in the preparation of charcoal in their localities (Table 15). In other words, local communities living in the area use available trees as an input for charcoal preparation on condition that options are limited for better trees by also compromising the market price due to low quality of the charcoal prepared.

Table 15. Knowledge of charcoal producers in determining most appropriate tree species for charcoal production

Knowledge on appropriate tree species selection	Response	Frequency	Percent
All tree species are used for charcoal preparation	Yes	6	6.2
	No	91	93.8
	Missing value	3	3
Acacia Niolotica	Yes	20	20.6
	No	3	3.1
	Missing value	3	3
Prosopis juliflora	Yes	25	25.8
	No	0	0
Combretum acueatum	Yes	9	9.3
	No	15	15.5
	Missing value	3	3
Tamarix aphylla	Yes	5	5.2
	No	19	19.6
	Missing value	3	3
Total		97	99.1

Source: Own Survey, 2014

The same respondents were also asked another question related to charcoal preparation to choose the best tree species they prefer and most frequently cut for charcoal preparation (Table 15). It is clear to understand from the table that all four tree species are generally used to produce charcoal by the sampled respondents. However, about 24% of respondents use '*Prosopisjuliflora*' for the preparation of charcoal. The second about 29% were use '*Acacia niolotica*'. *Acacia niolotica*' is one of the most invasive and unwanted tree in Afar. Its removal or cutting is generally considered as means checking its speedy spread across the region.The second tree type used for charcoal preparation by the respondents was '*Acacia. Nioloticawith* nearly 21%of therespondents use it to prepare charcoal out of it. '*Acacia. niolotica*'is listed among the indigenous tree species and the illegal cutting and use of this tree is prohibited by the national and regional indigenous forest protection low of the (*Proc. No 5. July, 2011*). The least utilized or proffered tree species was '*Tamarixaphylla*'and only 5.2% of the entire respondents consider it as important and make use of it in the preparation of charcoal.

Based on the figures presented in Table 15, it is possible to generalize that, the tine process of preparing charcoal from the 'most hated tree species in Afar'- ***Prosopis juliflora*** in2005 won the interests of local residents for its encouraging income that was considered as alternatives to their principal sources of income. The unexpected problem that emerged in the area in relation to the beginning of charcoal preparation was the spread of charcoal burning to other localities, which in the meantime switched to utilizing other indigenous trees.

Table 16. Engagement in the charcoal production within a year

Response	Frequency	Percent
When money is needed	39	39.0
All the time	61	61.0
Total	100	100.0

Source: Own Survey, 2014

The computed result shows that 61% of the total 100 sampled households go to the forest on daily basis and take part in the preparation of charcoal. On the other hand, the remaining significant number of respondents (39%) reported that they engaged in the charcoal preparation only when they fall short of money (Table 16). Respondents were also asked to tell where they

were used and prefer to produce charcoals. The reaction of the respondents to this question is presented in Table 17.

Table 18, depicted that, although, the preferences of respondents vary; they produce charcoal at different places. Accordingly, the result shows that almost 24% of the respondents' preferred to burn charcoal inside forest-covered areas (Table 17).

For them, this provides the best option to obtain abundant inputs with little energy to transport cut tree from its sources to the burring site. Equally, about10% of respondents reported that they preferred production of charcoal inside protected areas. Protected areas according to their explanation, if well planned are the most preferred place to hide in and prepare charcoal. According to them charcoal harvesting and packing would be made during the day light hours but the release of smoke and transporting the harvested charcoal would take place at night when everything is confirmed calm.

Table 17. Production areas of charcoal

Location of Charcoal production	Response	Frequency	Percent
Around residential area	Yes	8	8.2
	No	16	16.5
Around farm plot	Yes	3	3.1
	No	21	21.6
Inside forest area	Yes	23	23.7
	No	2	2.1
Around protected area	Yes	10	10.3
	No	14	14.4
Total		97	99.9

Source: Own Survey, 2014

Very few respondents (8.3%) produce close to their residence and these group produce charcoal in small quantity. The quality of the charcoal produced at this site is poor due to limited availability preferred trees close to their doorsteps. These people generated limited income from charcoal production as compared to those who manage to produce inside forested areas or inside protected forest territories. On the other hand only 8% and 3% of the respondents replied they produce charcoal close to their residence and farm plots. For these people charcoal is considered additional sources of income and brought close to their work place close to the farmlands. These people were engaged in both charcoal burning and farming. Therefore, it is an ideal place to

produce charcoal while also working on their lands or keeping their livestock. In line with production of charcoal, the most important market place for the sale of good was also assessed and the results are presented in the Table 18.

Figure 11: River side indigenous tree cut for charcoal preparation

Source: Own field photo, 2014

Table 18.Market area of produced charcoal

Location of market areas	Response	Frequency	Percent
Near production site	Yes	33	33.0
	No	1	1.0
Road side	Yes	14	14.0
	No	19	19.0
Addis Ababa	Yes	9	9.0
	No	24	24.0
Total		100	100

Source: Own Survey, 2014

A good number of respondents (33%) sale their good near the production site. Out of the total about 19% of respondents' sale produced charcoal along roadsides. Only few (9%) of the respondents send ready charcoal to other towns especially looking for good market prices in Addis Ababa. The remaining respondents did not have more preferred market place to take their products for sale. In other word they sale their goods wherever appropriate to do their business.

Table 19.Reasons for cutting indigenous trees in the area and interests to be organized in group/charcoal producers association

Tree preferences	Response	Frequency	Percent
Prefer indigenous tree over the other	Yes	39	40
for charcoal production	No	11	10
Interests in group/charcoal producers	Yes	38	39
association	No	12	12
Total		97	97

Source: Own Survey, 2014

It is clear from the very beginning that, one of the objectives the research is to measure charcoal production for commercial purpose and its effects on the existence of indigenous tree species. This was well described in the Table 19.Accordingly, of the total sample respondents, 40% of them confirm that their number one preference is to prepare charcoal from indigenous tree species. For them, charcoals produced from indigenous trees are of high quality and their demands in the market are very high compared to charcoal produced from '***Prosopis juliflora***'. An encouraging part of the survey was that these people (39%) are also willing to form an association, on the one hand hopping to secure their future business and on the other hand to contribute to the protection of indigenous trees from being cut and burnt.

4.9 Aspect of governmental rules and regulation

4.9.1 Objective, measure, success and challenges

The researcher tried to gather information from government officials such as head of agriculture and rural development), on issues of their objective and mission regarding charcoal production and trade in the woreda.

First charcoal production trade started here in 2004/05. It was established by NGO called FARM AFRICA by stabilizing two cooperative and giving them different material for the production of charcoal, the prosopis tree invade all pastoral grazing area, settlement area and cropland. Our mission and objective was to benefit or give some sort of solution to pastoral people in finding the alternative choice to use prosopis and they started converting prosopis to charcoal to business society in small scale by forming cooperative with the help of farm Africa. In that time their

good material for production of charcoal. It means charcoal is produced in a way that is not polluted the environment and only produced from prosopis tree. Now the time charcoal business become out of control for them. Now days, indigenous trees are destroying by charcoal producers under the name of prosopis. The indigenous tree resource is endangered. They tried to ban the charcoal business activity at all but they can't. Now the time they're struggling to minimize the scale of production. They tried to take measure on the charcoal producer by confiscate and bring their produced charcoal to prison. Once up on a year they started collect tax from the charcoal producer that exported the charcoal from Gawane *Wereda*. For the future they have plan to continue or allowing making or producing charcoal from prosopis and by protecting the indigenous tree. This dergihara or prosopis tree must be eradicated. This tree or prosopis tree injuring the pastoral people in different ways such as invading all grazing area of pastoral people and decreasing the number of livestock. Generally, they are interested in protecting indigenous tree and eradicating prosopis and converting to charcoal business for the society. The goal of the policy was to turn or convert or enhancing the economic advantage of prosopis to pastoralist society to control the invention of prosopis. The main aim of eradication of prosopis tree is by cutting the prosopis tree to create good grazing and cropland to the injured pastoral community."

Measure: until now they have no measure taken in place to address the challenge except try to apply that rules and regulation. They cannot control the production and trade of charcoal in *Wereda.*

Familiarity: they have good regulation to control and manage charcoal production and trade the related illegal activity but until now it was not successful. Because of different reason example the big gap between the *Wereda* and regional authority on the perception of charcoal business, the security body did not focus on the issue of charcoal business and the neighboring region not collaborate and help on the issue of charcoal management issue.

Success: they have article on illegal activities and resultant penalties suddenly the illegal produced charcoal confiscate by the government regulation. Sometimes they apply the rule but most of the time it was not successful"

They had taken the panel discussion with charcoal producer to stop the illegal production and trade of charcoal, creating awareness on the rules and regulation of charcoal production and trade in different time but it was not successful. Collaboration with some NGO they didn't tried to create awareness on the negative impact of charcoal production and trade for charcoal producer. They have no future plan to give training as well as create awareness so as to minimize indigenous trees' damage.

4.9.2 Specific proclamation, related articles on the use of prosopis for charcoal and resultant penalty on illegal charcoaling activity

The researcher also assessed the existence of specific proclamation on the use of prosopis charcoal production. The researcher found there is approved rules and regulation in June 30 2003 E.C that is "proclamation a regulation issued to control, manage and eradicate the invasion of prosopis in Afar Regional State. Under this regulation it include as the plant is thorny, it is causing considerable physical damage to human being and animals thereby forcing pastoralist leave their normal abodes. 'This rule permits pastoral community to produce and sale charcoal from prosopis". The section below is an extract of some of the legal procedures formulated with an emphasis on how to control the spread of Prosopis and its physical damages to natural resources and the livelihoods of the pastoral communities.

Whereas the alien invasive thorny plant known as prosopis, which is also referred to by the communities as '*dergihara*[1]' has in some *Wereda* of the region rapidly expanding inflicting enormous damage to the community and biodiversity by over taking grazing and arable lands, intrusion in to water canals and water drinking points, trails and residential area;

Whereas the plant is thorny, it is causing considerable physical damage to human beings and animals there by forcing pastoralist to leave their normal abodes.

Where as it is deemed necessary to control and halt the expansion of prosopis, control it through utilization, minimize and eventually eradicate it through the adoption and implementation of regulation.

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[1] *Dergihara* is a local name which used to refer prosopis julifera

Now therefore, this regulation is issued according to the mandates conferred to the council of Afar National Regional State by article 56 (5) of the amended 2001 constitution.

The rule includes;

Article --- 4 prosopis invasion management and control strategy

- Cut tree to produce timber, charcoal and other utilities and design an appropriate land use scheme to eventually turn the land in to productive use.
- Device mechanisms that enables to change prosopis in to various utilities
- On determining charcoal production site at areas where such can be practiced by using prosopis as inputs
  A. Designating charcoal production sites
  B. Undertake stringent regulation and precaution to avoid wild fires breaks during charcoal production from prosopis.
  C. Device a mechanism and implement land reclamation rehabilitation mechanism on the land used for production of charcoal etc.

Article 14: illegal activity and the resultant penalty

Unless the circumstance of the case will not aggravate the penalty, if a prosopis user does not cut the root of the plant 30 centimeter and deeper in to soil

A. She/he shall be served with strict written warning
B. She/he will be penalized with a fine ranging from 300 to 500 birr
C. The forest product will be confiscated and she shall be penalized with a fine ranging from 300 to 500 birr
D. According to the gravity of the offence, he shall be penalized with one of the penalties under sub articles a to c of this article and permit shall be revoked

3. A person or cooperative who negligently left the plant without eradicating the branch or thorny part;
   A. Shall be served with a written warning
   B. Shall be penalized with a fine ranging from 500 to 2000 birr

4. Any one engaged in charcoal production from indigenous tree or sells such as forest product in his/her hand shall be confiscated and she/he shall be penalized with a fine ranging from 2000 to 5000 birr or
    A. The forest product in his/her hands shall be confiscated and she/he shall be penalized with a fine ranging from 2000 to 5000 birr
    B. The forest product in her/his hand shall be confiscated and she/he shall be imprisoned for a time ranging from 6 month to 2 years.
    C. For grave offence the penalties under A and B above shall be currently applied.
5. Anyone who produce charcoal from prosopis in excess of the condition of the permit that she /he was granted with or transports such, according to the gravity of the offence, shall be penalized with imprisonment ranging from 3 month to 1 year in addition to confiscation of the property.
6. Anyone who does not collaborate with the effort to control prosopis and who puts an obstacle in the prosopis cutting activity or who incites others to the gravity of the offence;
    A. Be penalized with a fine ranging from 150 to 300 birr or
    B. Be penalized with imprisonment for a time ranging from 3 to 6 month
7. It is prohibited that government employees to be engaged in manufacturing charcoal out of prosopis .it therefore follows that anyone guilty of such an act shall
    A. Be served with a written warning in addition to confiscation of the prosopis product in his /her hands
    B. Be penalized with a fine ranging from 300 to 3000 birr in addition to confiscation of the property ,
    C. Be penalized with imprisonment for a time ranging from 3 month to 1 year according

We have specific rules to reduce illegal cutting of indigenous tree under prosopis regulation;

Trees prohibited from being cut means

A. Existing indigenous tree,shrubs and other natural forest of woody nature growing naturally including kesulto, gersa, kusra, ouda, tekbaleta, olayto, axangalita, subla and sukuhtoett.

B. Tree from productive forest developed privately, collectively, by the governmental or non-governmental organization for various purpose

4.9.3 Perception of regional expert on increased production of charcoal

As the researcher try to gather from regional NRM office expert his perception on the increased production and trade of charcoal in the region In the meantime farm Africa came up with provoke eradicating or managing prosopis by using prosopis for charcoal strategy. Because of this the charcoal production and trade scale up from time to time. The network is structured from the management body (upper level) to lower level. After that the business attracted many people.

In the first place when the people in the area started the charcoal production and trade because of prosopis after some time participation and involvement level society increase in time to time in the area. Then after, the charcoal producer changes their focus because of their selfishness they start to destroy the indigenous tree resource. When the government understands the expansion of and negative side of charcoal business government establish a new rules and regulation on the prosopis. By the name of prosopis they start to cut indigenous tree. All the time the regional government give training and workshop regarding this issue even the rule and regulation is in the hand of court, why not the respect government because the government body themselves are directly involved in the business. This illegal charcoal production and trade leads to the destruction of riverside and other area indigenous tree. for the future the future generation will have no chance to see them(indigenous tree) other part of the country there no more production and trade of charcoal but most of them are mainly use the afar regions produced charcoal. Now the time, some government expert go to charcoal production area and have try to claim and announce about the rules and proclamation of charcoal but nobody could hear them.

Before ten years the incidence charcoal production and trade is no knowable and understood by the Afar pastoral people in that time simply the highlander tried to produce and sell the charcoal In small scale but know the time all the people aware about charcoal business profit even they named as black gold.

If they use or operate charcoal business in a proper manner it was good. Means in means by respecting and applying the rules and regulation that set by the government unless and otherwise it not good. May be it gives them some temporary profit but it will be endangered for the future generation. if we take Kenya as an example they use prosopis for different purpose and they named as 'our mother'. In Kenya they use the prosopis pods for different purpose, they use prosopis wood for charcoal and timber, also they have different association and they have also license for their activity and they also give tax to the government. After that they also have a system of collecting some percent their profit in the bank and refund again on replanting tree on the place prosopis. Even they produce chairs from prosopis wood and Keck from prosopis pods. They can produce also chairs from prosopis wood. So it has its own role in increasing and expanding the income pastoral peoples if they have used in proper manner. The region has no specific forest protection policy also. So it is difficult to control and manage the natural; resource without specific policy. So now the time this charcoal producer may get temporarily benefit. Means small portion of the community may get some temporary benefit not at all from the charcoal business. Not all the community is benefiting from the business. it is not sustainable activity. If this charcoal producer continued their illegal cutting of tree afar region will become zero level from the indigenous tree. For the future there will be no more indigenous tree. To replant and rehabilitate the indigenous tree it takes time from 40 to 50 years averagely ok when they replant and where they are replanting tree nothing is there. There is no more replanting tree. So generally it cost or negative impact of charcoal business is high and greater than benefit of charcoal.

The government has set the rules and regulation but it is not become functional at ground level because of different reason. The main reason is lack of political commitment between government and the people. the regulation has good direction and order to produce charcoal from prosopis, the regulation says charcoal production must has specific production area and has to cut only prosopis tree but the charcoal producer didn't like the to follow regulation and they want simply by their selfishness go ahead on this activity as they want.

So now the time the charcoal is produced and exported day to day from the region day to day illegally without any license from the regional government. Even now the time the regional government and even the federal government are silent on this issue. It is knowable that these illegal cuttings of tree leads to and contribute to global climate change but they become silent at the moment.

Afar region have not land policy means have not specific land use planning policy. in a sense this place for commercial purpose, this place for farming, this place industry so the region has not such kind of land use policy. This means they are working haphazardly. The land is simply owned by clan leaders. One of the reason to illegal charcoal business activity is the region has not specific land use policy. Means charcoal producer has not specific area to make charcoal. For that reason the charcoal producer cut the indigenous tree resource as they want.

It is possible to understand from the aforementioned interviews organized with different governmental and non-governmental organization that, the process of charcoal production which was started to remedy the rapid expansion of prosopis tree and check its irreversible damages it has caused on the natural resources (grazing land, farmlands, etc) reached to the level of stopping charcoal production from prohibited trees. The charcoal owners prefer prohibited trees for the production of charcoal of for improved profit while the governmental and NGO's encourage charcoal production only from the invasive tree. IN some section of the interview, one could generalize the level to government bodied reached to the point where they are unable to stop the business. This is partly contributed to the life changing benefits coming out of the business and partly due to direct or indirect involvement of the government officials in the business. These groups lacked political commitment to fully discharge their responsibilities in stopping or reducing the negative outcomes natural forest removal.

In summary , one could understand and draw conclusion from an intensively made and presented interview that, in the first place charcoal production was formally began with help of an NGO whose intention control the invasion of Prosopis tree. However, the local communities turned their many to expanding engagement into the charcoal production out of the indigenous trees after they realized the difference in terms of demand and market price of charcoals made of

prosopis and other trees such as acacia. Thus, the production of charcoal and the lucrative profits that has changed the livelihood of those involved in the business has also attracted local officials which latter reached to the point where government officials themselves unable to control illegal cutting of trees and the application of legal procedures they has developed.

CHAPTER FIVE

5. Conclusion and Recommendations

5.1. Conclusion

Literature evidence indicated that charcoal production is inevitably followed by associated environmental problems such as the depletion of preferred species, forcing producers to resort to lesser-used species and, critically for livelihoods, food-bearing trees. Where charcoal is produced in quantity, localized deforestation has lead to social, economic and ecological impacts natural inevitable.

The study was conducted in 'Galeila Dora' Kebele Administration, Gewane *Wereda*, Afar Regional State. The main purpose of the study is to understand social and economic impact of charcoal production and its effect on livelihoods of pastoral communities in 'Galeila Dora' Kebele Administrative, Gewane *Wereda*, Afar Regional State. The data were collected from 100 head of households (HHs) actively engaged in charcoal production. Since the number of charcoal producers is small in size, it was decided to consider all charcoal producer HHs in the study.

To address the objectives of the study, both quantitative and qualitative methodologies were used in this study. Data were collected from different sources including secondary sources, exploratory survey (informal discussion with key informants and focus group discussants with pastoralist community and physical field observation) and formal household survey.

The key actors involved in charcoal production and marketing are local community, charcoal owners and or traders and charcoal makers. According to the survey result the vast majority (99%) of charcoal producers in the study area use the traditional/earth mound method of charcoal production in a series of traditional methods and processes.

The result of the field survey revealed that about 61% of respondents in the study Kebele engaged in the production of charcoal throughout the years. Moreover, about 38% of the selected respondents reported that they use charcoal profit for household expenses. Those who are addicted to chat (34%) use the gains mostly to cover chat expenses. School and medical expense constitute 16% and 12%, respectively. Furthermore, the finding indicated that there are indications, be it legal or illegal, of improvements in living condition of many residents. For instance, there are people who manage to buy Isuzu vehicle, while some other groups improved the quality of their housing units from locally made low quality seasonal shelters to modern houses whose roof were covered with corrugated iron sheet. Despite the benefits, nearly half of (51%) the respondents reported that existing social life is being disturbed by the presence of charcoal driven conflict between charcoal makers (employees) and local communities, which are found around the site.

On the other hand, wide majority of respondents in the study area (93.8%) consider all trees in their surrounding are appropriate for charcoal production. This implies, local communities living in the area use available trees as an input for charcoal preparation on condition as long as the market price is promising. In this regard, about 24% of respondents' use '*Prosopisjuliflora*' for the preparation of charcoal. The second about 29% use '*Acacia niolotica*'. *Acacia niolotica*' is one of the most invasive and unwanted tree in Afar. Its removal or cutting is generally considered as means checking its speedy spread across the region. The second tree type used for charcoal preparation by the respondents was '*Acacia. niolotica*'with nearly 21%of the respondents use it to prepare charcoal out of it. Close to 40% of the respondents replied that they prefer indigenous tree species for charcoal preparation.

Surprisingly, about 55% of respondents were not prepared to stop engagement in charcoal preparation as charcoal has become good source of income. Of the total respondents, more than half of the respondents (55%) do not know the negative effects of charcoal burning on forest resources. Equally, around 37% of the respondents do not know the negative impacts of charcoal burning on the quality of local environments.

Finally, With respect to charcoal production, there appeared proclamation allowing the use of prosopis tree and strictly prohibiting all other indigenous trees. In spite of this, putting this in to practice remains challenging and unsuccessful with consequent devastation of indigenous trees continues. This has happened partly due to firm resistance of the local people not to go away from charcoal production and partly due to the direct or indirect involvement of some government officials in the illegal business of charcoal production and trading, so prior attention should be given to cure this pressing problem.

5.2. Recommendations

Forest degradation and the associated socio-economic impacts of those dependent on these resources need to be tackled through stimulating and designing development initiatives especially through linking poverty, livelihoods and energy with sustainable resource management. More specifically, based on the findings of this study the following recommendations are forwarded:

- Massive awareness raising on the resource management and empowering communities to take the responsibility of protecting the environment and enhancing and helping local institution of community is an important key factor that will contribute to the reduction of the current rate of deforestation.

- Lobby and advocacy: The issue of deforestation of indigenous trees is the most critical issue that might lead to regional and local environment disaster, which would be difficult to reverse or would take long time to recover. Thus, lobby and advocacy activity should be carried out by the local government, NGOs and civil societies involved in the environmental projects. Full participation of communities and their institution in all stages of such interventions is also important.

- The government should place more emphasis on managing land in collaboration with the local people. Thus, Participatory community based environmental rehabilitation interventions through establishment of grazing reserves (sustainable pasture management), soil erosion control, and establishment of bio-diversity reserves, soil conservation and planting indigenous trees programs need to be established. Besides, Charcoal to be burned only by people with permits in specified areas, but this is not realistic, as charcoal production has become widespread occupation among pastoral communities. Community elders should also be involved in the tree cutting permit issuance. Community elders in the areas around production sites should be given a role in tree cutting permit and patrolling of the production sites. To obtain a charcoal permit the headman of the area first has to indicate whether there are trees to burn for charcoal and where they are. Through the wereda administration, the applicants for permits should dispatch a letter to the government who will then issue the license in consultation with the community elders of the locality.

- The potentiality use of the fast growing/spreading Mesquite plant (*prosopis juliflora*) for charcoal and firewood should be systematically explored. This plant has already covered large areas, mainly along seasonal water courses, grazing area, and settlement area and cropland.

- Any intervention that seeks to control the scale of indiscriminate tree cutting, or, rehabilitate the environment will prove difficult to implement successfully without improving the livelihoods of the community. Currently the living condition of pastoral people in the area is partly dependent on charcoal production. On the other hand, it would be better to create alternative income earning activities to those agro-pastoral communities such as bee keeping, poultry farming, petty trading, fattening, and agro-forestry and agro-pastoral as well as provide them with other financial and technical assistances to improve their farming production.

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Appendix 1: Rough estimation of charcoal production in quantity (per 50 kg suck) and Isuzu track transported away from Gewane woreda in the last five years (in E.C.)

Year	Average number of sucks loaded per Isuzu track	Average number of Isuzu track left the area carrying charcoal			Average number of sacks loaded		
		Daily	Monthly	Annually	Daily	Monthly	Annually
2000	270	8-12	240-360	2880-4320	2160-3240	64800-97200	777600-1166400
2001	270	10-15	300-450	3600-5400	2700-4050	81000-121500	972000-1458000
2003	270	20-30	600-900	7200-10800	5400-8100	162000-243000	1944000-2916000
2004	270	30-45	900-1350	10800-16200	8100-12150	243000-3645000	2916000-4374000
2005	270	25-35	750-1050	9000-12600	6750-9450	202500-283500	2430000-3402000

Source: Own Estimation, 2014

NB.

- ✓ An approximately on average, from 30-40 **indigenous tree** are required to load one Isuzu track (produce 270 sacks) whereas,
- ✓ An approximately on average, from 80-90 ***prosopis julifera*** tree are required to load one Isuzu track (produce 270 sacks)
- ✓ The price per 50 kg sack of charcoal in the market area in 2000 E.C. was approximately 35 ETB where as the price ranged from 110-130 ETB in 2005 E.C. However, seasonal variation, transportation security as well as the quantity and quality of charcoal makers has been causing the price of charcoal.

Appendix 2: Household Survey

Questioner no_____

Topic: socio-economic and ecological impact of prosopis related charcoal production and trade in afar region case study in gawane wareda

This questionnaire seeks to ascertain information from individuals like you in aid of an academic study (thesis) for the award of an MA degree at the AAU college of development studies in the center for environment and development . In the light of this, I hope you would furnish me with quality information to make this study successful please.

Part I Background of the respondent

1. Sex: A. Male B Female
2. Age: A. 10-25 B 26-40 C 41-55 D above 56
3. Academic status: A. Primary B. High school C. College D. Illiterate
4. Marital status: A. Married B. Single C. Divorced

Part II Question To assess socio-economic impact of prosopis related charcoal production and trade.

1. What methods do you use for charcoal processing?
   A. Traditional earth or saw-dust mound procedure C. Mobile metal kiln method
   B. Pit kiln method
2. What kind of agreement between you(owner) and charcoal maker_____
   _____
   _____
   _____
3. Is there any disagreement and conflict between charcoal maker and owner or trader? A Yes B. No.
4. If so what are the cause for conflict?

A. Barrier of communication C. Delay of input material for production charcoal

B. Delay of allowance D. Other

5. Is there any physical or mental damage because of conflict? A,Yes B,No
6. If yes what type damage or problem that occur because of conflict?

A. Health problem B. Death C. Psychological problem D. Other specify _____

7. Who is the main user of your produced charcoal?

A. Hotel B. Restaurants C. drivers D. Surrounding community

8. How often do you engage in charcoal production in a year?

A. When in a needed of money B. Dry season C. All the time

9. Do you think charcoal business contribute to your welfare? A. Yes B. No
10. If yes, in what ways does it support you?A. Household expenditure B. Children school expense

C. For chewing chat D. For entertainment E. To cover medical expense

11. How much money you expend for moving charcoal from production site to consumption area or to market area and in what area you expend it?

_____

12. How you fix the price of charcoal per bag? A It depends on condition of demand B . It depends on condition of supply C . It depends on our interest.
13. Where do you sale the produced charcoal?

A. Inside the woreda B. Outside the woreda C. Both

14. How you handle your profit and where you expend it? A. Save in bank B. Buying transportation material like Isuzu car C. Construct high standard house D. Chewing chat
15. What is the challenge you over come in charcoal burning activity? A. Falling of the rain on the produced charcoal and make expire B. Different wild animal become dangerous for us C. Conflict with a local community D. Inputs for charcoal production problem

25 Do you think it has good quality for use of charcoal? A. Yes B. No C. Don't know

26 Do you think it is beneficiary for charcoal burner to form themselves into association

A. Yes B. No

27. Are all trees (woods) favorable for charcoal production? A Yes B No

28. If No, which type of trees used for charcoal production? A. acacia B. prosopis C. seganto

29. Does user prefer some category of charcoal to other A, Yes B, No

30. If yes why

_____

_____

_____

_____

31. Where do you often burn or produce the charcoal

A. Around house B. Farm plot C. In the forested area far from the town D. protected area

32. Do you replant trees some time after cutting some for charcoal production? A. Yes B. No

33. Do you know whether charcoal production reduces forest cover? A. Yes B. No

34. Do you think charcoal production has negative effect on the environment? A. Yes B. No

35. As your opinion which measure is best to reduce environmental effect on the area?

A. Replanting tree B reducing illegal cutting of tree C . legally licenced production of charcoal

36. Do you harvest a large forested or living area of wild animal? A. Yes B. No

37. Do you know about environmental pollution?

A Yes B No

38. If yes what do you think to reduce pollution?

A,replanting tree B,reduce deforestation C,reducing illegal cutting of tree D,legally licenced production of charcoal E,other specify _____

Questioner for woreda and regional auothority or cabinate

1. As government, what is your mission about prosopis related charcol trade and production in Gewane worea?
2. Does you have some specific policies regarding the use of prosopis of charcoal?
3. If Yes, could you outline them?
4. When were the policies formulated?
5. What are the goals and objectives of the policies?
6. What are the challenges ,failarity and success of your policy? List them
7. Do you currently have any related intervention about prosopis related charcoal production and trade in the area?
8. If Yes, could you describe them
9. Do you have some specific law on charcoal production and trade in the area?
10. If Yes, could you mention them
11. What measure are in place to address the challenges
12. If Yes, do you have district/woreda program on mitigating the negative impact of prosopis related charcol production and trade on social and the environment in the area?
13. How about awareness creation on charcoal preparation and environmental pollution?
14. Do you have experience of banal discussion with charcoal producer or owner
15. What do you think planned to reduce deforestation and environmental pollution in the area?
16. What do you planned to replace the deforested area due to charcoal producer?

Check lists to guide focus group discussions and key informants

1. Who are the producer and trader of charcoal?
2. How you have looked the progress of prosopis related charcoal production and trade from year to year?
3. In which area is the first production of charcoal started from gawane area?
4. What type tree was used for production of charcoal before this time? And now?
5. if no how charcoal trade was going on?
6. What are the inputs of charcoal production
7. Where do you sell the produced charcoal?
8. How the charcoal supplied to market to other part of the country?
9. Is Through blocker or directly by the wholesalers?
10. If whole seller for whom the charcoal is distributed?
    - ✓ for retailers
    - ✓ for user
11. cost variance
    - ✓ how much the price of charcoal at production area
    - ✓ How much Price charcoal at the main road
    - ✓ How much Price of charcoal at the market area or adis ababa
12. Is there any natural and human made problem when you are in the production area of charcoal?
    - ✓ If yes describe all problems related to charcoal production

13. Before 10 and 30 years ago In this area how was the condition of forest cover and wild animals?
14. Before 10 and 5 years ago how was the condition of charcoal production and trade in this area?
    - ✓ What type of wild animal and forest was in this area?
    - ✓ Currently how was the condition of wild animal and forest resource
    - ✓ What do you think the reason for the depletion of wild animal and forest in this area?
    - ✓ What was the role government body to protect forest and wild life
15. Before 5-10 years ago how was the condition of charcoal production and trade in this area?
16. What is the role of production and trade of charcoal for the diversification of source of income to the pastoralist society?
17. How you see the cost-benefit analysis of charcoal production and trade relative to benefit of society and impact on the environment
18. Is there anything to recommend on the production and trade of charcoal?
19. What are the factors that determine the price of one max bag of charcoal?
20. Is seasonal variance like summer and winter determine the price of charcoal?
21. If yes in what way and how seasonal variance determine the price of charcoal?

Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any University, and that all the source of materials used for the thesis has been duly acknowledged.

Declared by:

Name: Mohammed Detona

Signature: _____

Date: _____