Gender-Based Indigenous Energy Use under the Changing Climate among Rural Communities in East Gojjam, Northwest Ethiopia

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Abstract

This study examined gender-based energy use under the changing climate change among the rural households in Sinan District of Amhara National Regional State. Data were gathered through a combination of qualitative and quantitative methods using key informant interviews, focus group discussions, observations and household survey. Data were analyzed thematically through triangulation of the various data sources to validate the findings. The findings revealed that gender-based indigenous energy consumption practices have changed in the study area owing to degradation of forest resources and other customary energy sources such as cow dung. The changes in such patterns of energy sources led the study communities to search for alternative energy sources such as eucalyptus tree (mainly for marketing), charcoal (mainly to generate cash), and crop residue (mainly for domestic consumption). These changes have brought a shift in women's and men's customary gender roles related to access, to control over and use of local energy sources. The micro climate change at local level had caused gender-differentiated challenges as women were mostly responsible for searching energy sources to be used for household consumption; whereas men were mainly engaged in planting eucalyptus tree and processing fuel wood and charcoal for marketing.

Key words: *Climate Change, Energy Use Pattern, Eucalyptus Tree, Gender, Indigenous Energy and Ethiopia*

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1. Introduction

Studies have demonstrated the occurrence of global climate change but the manner and extent of the challenges in a given locality or region has remained as an important issue to be addressed (Opere *et al.,* 2011). The disturbances of climate change on energy use pattern can be manifested in two ways. One, it increases tree mortality that either decreases the number of indigenous tree species or destroys them forever. Two, it decreases land productivity that, in turn, decreases crop residues and the number of cattle (Seitz and Nyangena, 2009). Climate change also invited those who have no alternative livelihoods to unfairly exploit their local environmental resources through over cultivation, deforestation and land encroachment that devastated local energy availability (African Partnership Forum 2007). These are considered as direct impact of climate change on the local environment and on communities' ways of living (Opere *et al.,* 2011).

Climate change is a potential threat to rural households' energy availability, accessibility and consumption. It discriminately affects poor households and women in Africa where people depend on the immediate environmental resource for their energy (Alexander, 2011). Compared with the rest of Africa, indigenous energy sources in sub-Saharan Africa are highly challenged by climate change and variability as natural resources are major and sometimes the only energy sources (Alexander, 2011; Woldeamlak, 2005). Ethiopia is negatively affected by climate change due to the strong relationship between natural resources, peoples' means of survival and indigenous sources of energy (Badege, 2001; Dessalegn, 2009).

Existing studies, such as Abebe *et al* (2012), are concerned with the effects of rural households on their surroundings, particularly through deforestation of natural forests for various purposes and use as a source of domestic energy. Tsigie (2012), for example, had studied about the negative effects of biomass energy on women's health. The study looked into the women's domestic energy consumption, particularly as it relates to women's time and energy consumption (Meseret, 2011). However, there is little data and empirical knowledge on the gender differences in the effects of climate change on indigenous energy sources.

Understanding the effects of climate change on gender-based indigenous energy use patterns (availability, accessibility, type and utilization) is critical, but it is not being addressed adequately. Climate change and variability threaten both men and women in a similar way. However, studies (such as Almaz, 2008) indicated that women are more negatively affected than men due to women's traditional gender roles related to processing food to household members. This article also indicates how climate change affects men and women differently when it comes to issues such as the availability, accessibility, use and control of indigenous energy sources. Men and women have competing interests when it comes to the utilization pattern and types of indigenous energy sources.

Therefore, this article is concerned with indigenous energy use patterns under local climate change with specific reference to rural communities in East Gojjam, Northwest Ethiopia, using gender as perspective for analysis.

2. Research Methodology

2.1. Study Area

This study was conducted in Sinan District, which is one of the seventeen districts in East Gojjam Zone of Amhara National Regional State, Ethiopia. It is about 327 kilometers northwest of Addis Ababa, situated in the northwest direction and about 28 kilometers away from Debre-Markos. According to CSA (2010), Sinan district had the population of about 98, 939 in which 49, 423 (49.9%) and 49, 516 (50.1%) were males and females, respectively. As the same source indicated, in Sinan district, Orthodox Christianity is the dominant religion practiced by almost all people (99.9%). Most people living in this district belong to the Amhara ethnic group and Amharic is their native language (CSA, 2010).

Gedamawit, the study site, is one of the rural *Kebeles* in Sinan district with 3,174 hectares of land size (Amhara Agriculture and Rural Development Report 2007). In 2007, it had the total population of 6,983 (3,461 males and 3,522 females). The total number of households was also 1224 (1070 male and 154 female household heads) (CSA, 2010). Gedamawit *Kebele* is further divided into seven sub-*Kebeles* known as *got* (at village level). From seven sub-*Kebeles*, primary data were collected from four sub-*kebeles:*

Gedamawit sub-*kebele*, Gebriel, Chero-Godeb and Lay-Chabi. These study sites were selected purposely based on their proximity to the capital of the district where there is high demand for energy consumption. Due to the high energy demand, most households are converting their farmland to on-farm eucalyptus production, which is replacing the indigenous tree species. On top of this, researches conducted in this area (Belay, 2011; Erimas, 2011; Sewagengew, 2011; Woldeamlak and Dawit 2011) revealed that climate change has affected the households use of indigenous energy sources either at home or for market.

In Sinan District in general and in Gedamawit *kebele* in particular, there is a division of labor among household members based on age and gender. Like elsewhere in Ethiopia, men are generally considered as household heads and responsible for all household members in the study area. Men are involved in farming activities such as plowing and other related activities and public related duties. Women are generally seen as housewives and are involved in taking care of their family members including food preparation and managing vegetables at their homesteads. Women are also engaged in several tasks outside home such as water and fuel wood collection, encouraging and assisting their husbands during farming. There are also female household heads (locally known as *emmaworra)* who are mainly widowed and divorced women. They manage children and household activities at home and outside, but sometimes being supported by their children and male relatives.

2.2. Methods

2.2.1 Data Collection Methods

To know the local communities' viewpoints about the effects of climate change on the indigenous energy sources and gender differential use patterns, primary data were gathered through a combination of qualitative (key informant interviews, in-depth interviews, focus group discussions and observations) and quantitative (household survey questionnaire) research methods, which are briefly explained below.

Key informant interviews were made with twelve individuals (seven women and five men) who were purposely selected based on age, sex, and knowledge of local history, culture and environment. The key informant interviews were conducted by using semi-structured and open-ended questions related to historical indigenous energy sources; gender-based roles and responsibilities related to the routines at home and patterns of indigenous energy collection outside home.

In-depth interviews were conducted with fifty informants to have detailed information related to informants' own experiences about the effects of climate change on the indigenous energy sources, problems they are currently encountering with, and their adaptive mechanisms to overcome shortage of energy. The fifty interviewees were purposely selected from four sub-*kebeles* (13 from Gedamawit, 13 from Gebriel, 12 from Chero-Godeb, and 12 from Lay-Chabi) among seven sub-*Kebeles* of Gedamawit *kebele*. From these interviewees, thirty were women (10 wives and 20 household heads), while twenty of them were male household heads. The majority of the interviewees were women because of women's high responsibility in indigenous energy related activities (collection and consumption) in the study area.

Data related to energy problems attributed to climate change were also gathered from participants of Focus Group Discussions (FGDs) to grasp group perspectives about energy problems in the study area. Group discussions were also used to identify social groups vulnerable to energy related constrains and to understand community members' views on alternative energy sources. For this, seven FGDs (both mixed and gender based aggregated) were organized in which each group consisted of 8 members on average.

Energy related information was also gathered through observation of men's and women's activities related to energy collection, consumption and marketing processes. Moreover, there were informal conversations with various community members and extension workers in the study area. This was to comprehend problems of energy related risks and vulnerability

situations of men and women, and to know about the existence of alternative energy sources.

In addition to the above-mentioned qualitative data collection methods, quantitative data was collected through household survey questionnaire, which was distributed to 136 household heads (109 male and 27 female household heads) through trained enumerators. From these, 128 (101 male and 27 female household heads) questionnaires were properly filled and used for the final data set. The questionnaire consisted of issues related to sources of indigenous energy and use patterns; gender-based responsibilities to provide energy and alternative energy sources at the household level; and the like.

To determine the study sample size, one of the common formulas used by social scientists is provided by Krejcie and Morgan (1970). Accordingly, the size of the sample was determined based on the following formula:

$$\text{Sample Size } (S) = \frac{x^2\, NP\,(1-P)}{C^2\,(N-1) + x^2 P(1-P)}$$

Where, *X2* = the chi-square value (3.841) for 10 of freedom at 95% probability level; *N* = the population size or Household number (*N* = 1226); *P* = the population parameter of a variable (*P* = 0.5); and *C* = the confidence interval chosen (*C* = 0.05). Therefore, based on the formula, the sample size of this study was 136 households. These households were randomly selected from the total of 1226 households.

2.3. Methods of Data Analysis

The data collected through different qualitative methods were organized and analyzed thematically and the survey questionnaire was analyzed with the help of SPSS software (version 16) and presented in tabular form. The survey findings were used to supplement the findings from qualitative data. Finally, the data were analyzed through triangulation of the various data sources to validate the findings of the study.

3. Review of Related Literature

3.1. Studies on Gender-Based Energy Production and Consumption

Gender-based energy production and consumption has been the subject of discussion among scholars, politicians and practitioners at least since in the 1970s and increasingly in the 1980s and the decades onwards (Danielsen, 2012). In the 1970s, the major concern was rural women's daily activities such as collecting and processing households' biomass energy from natural resource and the anticipated challenges that the women would suffer from as local environment changes (Cecelski, 2004). The same author further argued that, in the 1970s, studies concerned with gender and energy focused on the importance of biomass energy to rural households. In the studies, women were seen as the primary and direct beneficiaries, as they were primary victims of energy scarceness. This was attributed to the customary gender roles and responsibilities prevailing in domestic settings. Thus, the intent was to make the biomass energy sustainable (Danielsen, 2012), and help women move out of their suffrage.

The coverage of studies in the 1980s and 1990s were energy policies and services to mitigate energy problems that rural households in general and women in particular faced with. There have been policy formulations that enabled governments to provide alternative energy services to their citizens especially to rural households (Etcheverry, 2003). Here also women continued to be subjects of the focuses of the analysis. The primary notion was to help women to save not only their time but also their labor. This, in turn, made women shift to other options enabling them to change their lives by assuming that women have become beneficiaries from energy interventions. Among others, improved and efficient energy technologies and other mechanical energy sources were introduced in most parts of rural households of developing countries (Carr and Harti, 2010). The hope was to ease women's domestic burden and enable them save their extended time that they spend to collect and process the traditional biomass energy (Cecelski, 2004).

The available evidences show that there are only few success stories of past attempts to mitigate rural households' and women's energy problems. Most attempts were futile and did not bring significant changes (Jiggins,1994). This was due to "*lack of recognition of women's energy needs, knowledge, and contribution*" and due to "*the failed redistribution of control over resources and benefits from energy services*" (Danielssen,2012: 10). In connection to this, Cecelski (2004: 12) also explained, in the approaches of the 1970s and 1980s "*gender issues have rarely been mentioned in the mainstream literature*" and insufficient to provide detail information about men's and women's needs to policy formulators and practitioners including the energy access and consumptions as well.

The governments' gender-energy nexus approach of the 1980s continued until today and customary biomass energy remained still the major energy source of rural households (Danielsen, 2012). Likewise, there has been no change in rural women's customary role to collect and process biomass energy from their environment. According to Gaast and Begg (2012), until today, throughout the globe, more than three billion people depend on the customary biomass energy. From this number, 1.4 million people die yearly from the smoke where women and children take the lion's share. Hence, the previous studies had focused on the impacts of biomass energy on women's health conditions, on the local environment and on the ecosystem balance in general (Etchverry, 2003).

A study by Gaye (2009: 8) also showed that naturally available forests, livestock, and crop residues have been major sources of biomass energy to rural households of most developing countries. Collecting and managing fuels was strictly women's business and major activity. Although there was a strong challenge of climate change on biomass energy sources, these were continued to be the major rural households' energy source and the responsibilities continued to be women's domain, which also burdened them and attributed to energy scarcity.
Furthermore, World Bank (2011: 12) reported that, "*until recently, cooking with biomass energy was seldom addressed by climate change practitioners*

[and researchers]". That entails studying encounters of climate change on indigenous energy sources comprise a relatively recent theme. Now, there is a consensus among scholars and practitioners that the major drawbacks of the post 1970s literature were ignoring the possible challenges of climate change on the people who directly depend on their immediate environment for energy sources and for their livelihoods in general.

3.2. Biomass: An Indigenous Energy Source at Risk

There has been a strong link between biomass energy and that of the local natural resources. Both fall under the direct challenge of climate change and easily influenced by climate variability (World Bank, 2011). As a result, biomass is often referred as an extension of the natural resource and cannot be detached from agricultural activities of the rural people. As Lamborou and Piana (2005) stated, in most developing countries, especially in Africa, climate change and variability resulted in rural food insecurity, reduced land productivity, facilitated the destruction of natural forests and reduced animal diversity and increase the ecosystem disjunction and generally devastated the sources of biomass energy. This argument holds true in Ethiopia since biomass has obtained from natural resources and it is sometimes the only energy source of the rural households.

The link between climate change impact and that of local sources of biomass energy becomes more interesting when it incorporates gender dimensions in its analysis (Lamborou and Piana, 2005). Climate change differently challenges men and women in relation to energy production patterns, accessibility, utilization and making decision on the locally available energy sources. This is because, "*women and men in [Africa and Asia] are highly dependent on biomass and forest resources for energy".* It can be unstated that in the struggle to secure benefits from the energy sources, men often have the upper hand (Lamborou and Piana, 2005: 20).

In Ethiopia, the available literature covers much of the rural energy consumption and biomass energy scarcity that people often face in rural areas. Based on the data gathered from four regions of Ethiopia, the work

done by Abebe *et al* (2012) deals with fuel wood scarcity due to deforestation. Moreover, Abebe (2011) stated that almost all households in rural Ethiopia get their energy from the nearby forest areas, which contributed to local resource degradation. Thus, it is quite needed to introduce fuel saving technologies to conserve the natural resource. Having focused on Tigray region, a study conducted by Zenebe (2007) espoused that there was a relationship among land degradation, fuel scarcity and households' decisions of planting trees to overcome their energy problems.

Some other studies, for instance, Tsigie (2012) and Woldeamlak (2005) showed that in the highlands of Amhara, population increment has been resulted in the destruction of natural forests including tree species. As a coping strategy to the scarcity of fuel wood energy, households shifted their energy sources to animal dung and crop residue. According to Tsigie (2012:12), in Amhara region, although *"the pattern and level of energy consumption depend on the remaining size of the natural forest",* since rural Amhara households do not have any alternative energy to switch to, about 99% of energy comes from the naturally available biomass in which fuel wood accounts 58%, animal dung 19%, and crop residues 22% of the energy demand.

There were also studies done on the biomass energy consumption and on the provision of energy services as interventions intended to mitigate households' energy crisis in urban and rural Ethiopia. However, just like the above reviewed works, the results of the studies do not mainstream gender into their analysis and they were hardly bold to concentrate on gender-energy-climate change nexus. For instance, the work of Nebiyu (2009) reveals the inverse relationship between biomass energy and deforestation in the Harari region, Eastern Ethiopia. Moreover, the work by Meseret (2011) focused on the contribution of the newly introduced stove to the protection of natural resource in the city of Bahr Dar and the major constraints that affect households in general and women in particular. The reviews showed that the prevailing inattention on gender dimension of climate change and impacts on indigenous sources of energy had appeared to be an area little covered in the previous research engagements by scholars in the field.

3.3. Empirical Evidences on Climate Change and Gender-Differences

The study area is situated in the footstep of Choke Mountain (4,100 meter above sea level) in the Blue Nile Watershed. There are evidences showing that Choke Mountain and its adjacent land holdings, which the study communities depend on, are significantly affected by climate change. Among these, Temesgen *et al* (2009) studied societies' level of vulnerability to climate change in the Nile basin. Another research conducted by Zaitchik *et al* (2012) confirmed that, Choke Mountain Watershed areas, which also consist of the study population, are affected by "climate variability", "local climate contrasts", "erosive rains" and "erodible soils". This is accompanied by population pressure on the natural resources which make the study community "highly vulnerable to negative impacts of climate change" (2012:35).

Moreover, the work of authors such as Woldeamlak and Dawit (2011) supported the idea that climate change in the Choke Mountain Watershed has become observable. They confirmed that climate change presented gender differential impact on men and women. Ermyas (2011) and Sewagegnehu (2011) showed, primarily due to the impacts of local climate change in most parts of Choke Mountain and its surrounding area, the natural resources are severely deteriorated. For example, most of the streams and rivers in the area have dried up while some of them are severely reduced (Belay and Shibru, 2011: 10) that has triggered the vulnerability of the surrounding communities to several problems, of which scarcity of biomass energy is among the top (Belay *et al* 2012, Belay 2011).

Of the several communities residing at Choke Mountain and its vicinities, those living in Sinan *woreda* seem to be suffering most. Besides the shortage of water in the study area, the soil that the study households plow suffered from too much acidity which highly affected their successes in livelihood outcomes and energy consumption (Zaitchik *et al* 2012). Households who used to produce enough were now under livelihood

insecurity, vulnerable to socio-economic problems and are living in a scarcity of domestic energy (Temesgen *et al* 2009; Belay and Shibru, 2011).

4. Results and Discussion

4.1. Local Perceptions of Climate Change

Informants proved the change in the local climate pattern by indicating that temperature and rainfall have changed. They also reported about the destruction of natural resources and loss of biodiversity due to the change. They often explained vanishing indigenous tree species that have had served as bases of their lives. For instance, FGD participants mentioned the disappearance of several indigenous tree species, namely *wulkiffa* (D. bruceana)[1]; *zigba* (podocarpus tree); *aluma* (Amaranthus sylvestris)[2]; *koso* (Hagenia Abyssinica); *weyra* (Olea Africana)[3]; *korch* (Erythrina Abyssinica)[4]; and *grawa* (Vernonia mycrocephala). Adding on this, an informant espoused that,

> *Currently, except korch and grawa that are also disappearing from the neighborhood, the above tree species are disappearing and we have never noticed when and how they have gone. As a result, tree species that we used to collect fuel wood are also disappearing and we remained with tree species that are not good for our health when we use as energy sources.*

The tree species with different lengths and thickness had socio-economic significances to the community. An informant added that in the past "*not only farm areas but also residential areas were surrounded by indigenous tree species that have medicinal, socio-economic values; but now we are left with eucalyptus tree".* There are also *qutquato* (bushes) such as *qega* (Rosa Abyssinica) and *yabesha girar* (Acacia Abyssinica), which had been available everywhere and served as fodder for animals and as sources of fuel wood. These are also disappearing and rare to find in their locality. In the past, to fulfill their domestic energy needs and to use as a source of cash, the community members mentioned to depend on fuel woods from the natural forest easily available in their closer surroundings.

At large, the increases in the temperature and rainfall variability are the results of climate change and both have direct impact on the local natural resources. Ermyas (2011) and Sewagegnehu (2011) explained that an increase in temperature in the study area has a direct effect on the capacity of land productivity. It takes soil moisture through transpiration, which leads to the drying up of plants and vegetation on the land. Moreover, Aklilu and Desalegn (2013:22) espoused, "loss of productive land", "failure of crop production" and "decline in yields" are the direct results and important indicators of climate change impacts. These are intensified by the fact that, when the economy depends on climate sensitive activities. Likewise, for energy consumption, the people in the study area also depend on biomass energies that they obtained from agricultural by-products. However, their energy sources are highly sensitive to the challenges of climate change and this has become their daily experiences.

4.2. Gender Differential Challenges of Climate Change on Households' Indigenous Energy Sources

The extent of climate change challenge differs across communities, households, and differently impacts men and women (Aklilu and Desalegn, 2013). Based on the data obtained from the study area, the gender differential challenges of climate change on the indigenous energy sources differ across households with different wealth status.

To show climate change challenges on different households' indigenous energy sources, FGD participants[5] categorized and ranked households into three groups: better-off (*habitam*), medium income (*mekakelegna*) and poor (*deha*). This categorization is based on the type and amount of assets and wealth characteristics that households owned. Households' wealth ranking determines be it male or female headed, showed gender-based differences in patterns of indigenous energy usage. The summary of household' wealth ranking is indicated in Table 2 below.

Table 2: Local Criteria of Households' Wealth Ranking

Asset Characteristics	Better-Off Household	Medium Income Household	Poor Household
Land size in hectare	≥ 2 hectares (1.5 for crop and 0.5 to 2 hectares for eucalyptus)	0.5-2 hectares in which about 0.25 to 0.5 hectares of land is devoted to eucalyptus	Often do not have land or owned a plot of land devoted for vegetable
Type and number of livestock	≥ 2 oxen, a milking cow, 7 sheep, ≥ 2 horses	2 oxen, 5 sheep, a horse, a cow	No ox, no horse, 3 sheep, 4-5 poultry
Other Assets	Saving cash in a bank, tin-roofed houses in the rural Gedamawit and in the town of Rob-Gebeya	Tin-roofed house in the rural Gedamawit	Who spend most of his/her time as a laborer, petty trader
Other indicators	Use new farm inputs and technologies, sale eucalyptus tree, food secured, etc.	Only some of them use farm inputs; seasonal food insecurity if the rain does not come; inadequate cash	Begging, living in a hut made from grass roof, sharecropping; food insecure and poor health condition

Source: Field Research (September 16, 2017-June 2018)

Most of the FGD participants also believed that climate change did not challenge all households in a similar way. Thus, their way of adaptation to the change also differs. Households' characterization and categorization is also important to discuss the source and type of energy a household intends to use and how to use the energy at hand.

In addition to asset types indicated in Table 2, there are also other indicators used by the study participants to characterize and categorize households.

These are ownership of a house in the town and a bank deposit. In most cases, better-off households have most of the assets described above and here. Most of the "poor" households may have plots of land, but they, often give their lands to sharecroppers[6] in the form of what is known as *timado* (sharecropping land) since they lack either an ox or a horse to till their farm plots. As a result, they may not obtain biomass energy from crop residue. Most of these are female household heads as women in the area could not plow land. Moreover, the "poor" Female Household Heads (FHHs) who shared their land in the form of *timado* do not have on-farm eucalyptus tree. Thus, they have to search for alternative energy source, which is the natural forest. FHHs also rely on the naturally available energy sources obtained from animal dung that might have collected from the field where there are cattle. Compared with FHHs, most male household heads (MHHs) are categorized as medium income group and better-off. Most of them fulfill their energy needs from on-farm eucalyptus and sometimes from natural forest.

Table 3: Wealth Ranking of Households in the Study Area

Better-off HHs			**Medium Income HHs**			**Poor HHs**			**Grand Total**
MHHs	**FHHs**	**Total**	**MHHs**	**FHHs**	**Total**	**MHHs**	**FHHs**	**Total**	
222	4	226	392	10	402	458	140	598	**1226**

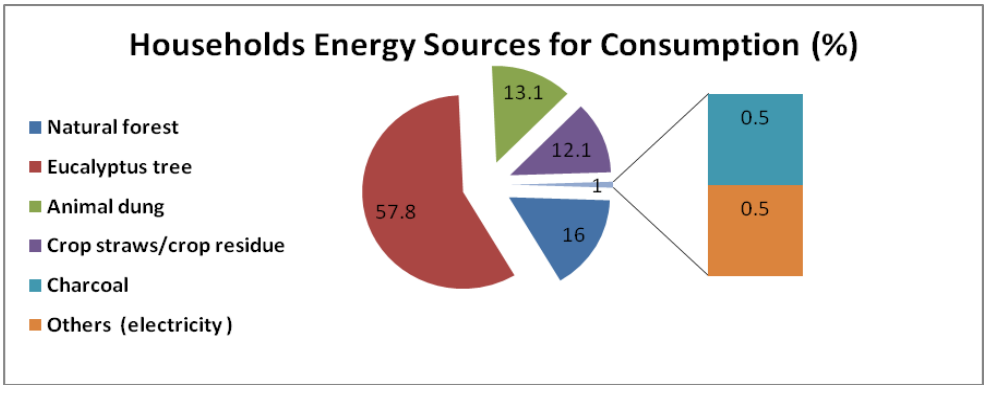
Source: Gedamawit *kebele* Administration (February 2018)

In the study *kebele*, as shown in the table above from the total of 1226 households (1072 MHHs, 154 FHHs), there were 226 better-off households (222 MHHs and 4 FHHs), 402 medium income households (392 MHHs and 10 FHHs) and 598 poor households (458 MHHs and 140 FHHs). Here, most of the FHHs were in the poor categories, constituting 92 % of the total households headed by females.

4.3. Men's and Women's Indigenous Energy Sources and Use Patterns

According to their priority, households use four types of indigenous energy sources. These are fuel wood, animal dung, crop straws and crop residues, and charcoal. They consider two of them, i.e., fuel wood and animal dung, as the most important while crop straws/crop residue and charcoal have become part of their consumption as they are increasingly getting into energy shortage. Particularly, crop straws and crop residue were used for home consumption while charcoal was basically used for marketing purpose. Chart 1 below shows households' responses on domestic energy sources. As indicated, 57.8% of the respondents use eucalyptus tree as their sources of domestic energy. This was followed by natural forest (16%). This means that 73.8% of the respondents used fuel wood as a source of domestic energy. Animal dung was also an important household energy source that 13.1% of the respondents use it. Then, crop straws and crop residue account for 12.1% used by respondents. Charcoal and others (electricity) constituted only 0.5% each. Charcoal was mostly used for market, while electricity was not introduced in the study, except in the smaller town.

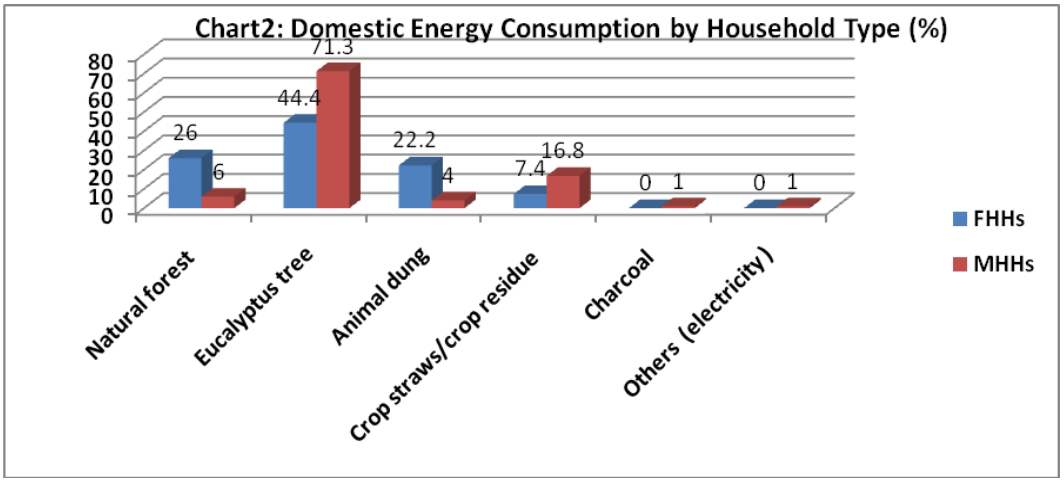
Chart 1: Household' Domestic Energy Consumption



Source: Household Survey (January- February 2018)

In using the different types of energy sources, there were differences between FHHs (Female Household Heads) and MHHs (Male Household

Heads). This means that access to and control over energy sources differ based on gender and the amount of wealth households (FHHs and MHHs) owned. This was indicated in Chart 2 below, which shows domestic energy consumption that female household heads (indicated by Blue Bars) and male household heads used (indicated by Red Bars).



Source: Household Survey (January- February 2018)

4.3.1. Fuel Wood

Informants stated that fuel wood was and still continued to be households' most important energy source for cooking, heating and lightening. As elaborated in Chart 1, most respondents used fuel wood (from eucalyptus tree (57.8%) and natural forest (16%) as their major sources of energy. In fact, compared with the natural forest, eucalyptus tree was the major source of fuel wood for domestic energy use.

As indicated in Chart 2, for both MHHs (71.3%) and FHHs (44.4%), eucalyptus tree was the major source of domestic energy. This shows that eucalyptus tree was mostly controlled by MHHs. However, there were greater numbers of FHHs (26%) that used natural forest as their major sources of energy compared with MHHs (6%). This indicated that still most FHHs rely on natural forest as they have limited access to eucalyptus tree and other alternative energy sources. Moreover, FHHs often transfer their

lands in the form of *timado* (sharecropping) instead of planting eucalyptus trees on their lands.

Informants elaborated those natural forests were sources of fuel wood and charcoal. In the case of fuel wood, it was for consumption at home and for market, while charcoal was mainly used for market. When fuel wood was used for consumption at home, women and female children were responsible to collect it. Particularly, in the case of spouses, women (wives) were responsible to collect fuel wood from natural forest only for home consumption, whereas men (husbands) used to collect fuel wood from natural forest for cash and also to process charcoal to earn cash. However, there were exceptions because female household heads and young males in the study communities used to earn income from the sale of fuel wood which they collected from the natural forest.

Currently, following the destruction of natural forest and indigenous trees, there is a change in the sources of fuel wood which, of course, varies across the different household categories discussed above. Owning and controlling a relatively large size of land ensures the accessibility of fuel wood from on-farm eucalyptus tree. Better-off and most medium income households had privately owned eucalyptus trees on a portion of land. Medium income households used fragments of on-farm eucalyptus when they need fuel wood for consumption while they supply the bulk of the fuel wood to the market.

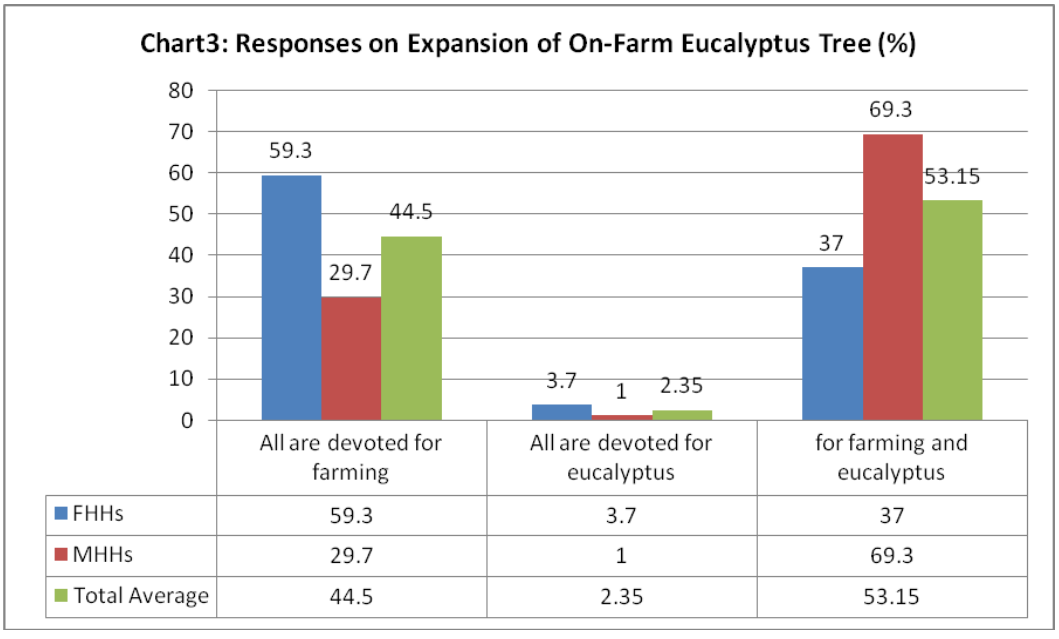
According to informants, due to the decrease in the fertility of their land, they have encountered with a continuous decrease in crop productivity and could not get grain as they had used to produce. The community groups had been using indigenous trees and forests as sources of energy at home and to generate income from them in the form of charcoal and fuel wood. An informant agreed and stated that *"though there are women and children who used to search for fuel wood far away from their residences, now some of us started producing both charcoal and fuel wood from on-farm eucalyptus tree".* Focus group discussion participants also agreed that, in the past two decades, the natural forests of their area have gone due to deforestation. The

remaining few hectares of forests have been protected by local administrators, though still there are intruders who cut down the indigenous trees.

Since, the past two decades, households have planted on-farm eucalyptus tree in response to the decrease in the productivity of land. Informants do not consider eucalyptus tree as indigenous though the informants did not able to remember when and how it was introduced into their locality. However, few of the informants noted that eucalyptus tree was available in their locality even during the regime of Emperor Haile Sellasie (1930-1974).

Households in the study area also planted eucalyptus tree after they have encountered with shortages of wood. Of course, on-farm eucalyptus tree was intensified in the area by the increase in the demand for wood in the nearby towns. They also claimed that on-farm eucalyptus tree in turn decreased the size of farmland that households owned and increased the land covered by eucalyptus tree. Subsequently, on-farm eucalyptus tree has become major source of fuel wood and charcoal. However, informants indicated that fuel wood was used for household consumption and market, while charcoal was mainly used for market. Hence, better-off and medium income households benefit from eucalyptus tree. Most better-off and medium income household heads were men. Therefore, incomes generated from the eucalyptus tree in the study area were controlled by men (husbands).

The majority of the respondents (53.15%) had on-farm eucalyptus tree. This was followed by those respondents who reported that they devoted all of their land to produce cereal crops (44.5%). From these, female household heads that devoted their land for both the production of cereal crops and eucalyptus tree constituted 37%, while male household heads comprised of 69.3%. This means that eucalyptus tree and its byproducts were the major energy sources. Moreover, 2.35% of the households responded that they devoted all of their farmlands to plant eucalyptus tree. Of this, women take the majority (3.7%) (see Chart 3 below).



	All are devoted for farming	All are devoted for eucalyptus	for farming and eucalyptus
FHHs	59.3	3.7	37
MHHs	29.7	1	69.3
Total Average	44.5	2.35	53.15

Source: Household Survey (January- February 2018)

Moreover, as indicated in Chart 3, the majority (59.3%) of female household heads devoted their land only to produce cereal crops (for farmland) rather than for planting eucalyptus tree. This is because, most of the women did not plow land they owned, but rent it in the form of sharecropping. Sharecroppers only produce cereals on the land they had rented from the women. In other words, women who rented out their land may not have on-farm eucalyptus tree. They do not also get crop straws and crop residue as these are considered as sharecroppers' properties. As indicated in Chart 3, 29.7% of male household heads responded that they devoted their land only for cereal production. This is mainly due to the shortage of land they accessed to plant eucalyptus tree. Furthermore, 3.7% of female household heads responded that they have planted eucalyptus tree on all the land they legally owned just to avoid farming and sharecropping.

In the study area, eucalyptus tree is considered as men's "property" because it is men that plant, manage and control. Thus, in most cases, supplying fuel wood for household consumption from eucalyptus tree is men's decision and responsibility. This may prevent women from managing eucalyptus tree

and from the benefit they may earn from the sale of eucalyptus tree. In this regard, an informant claimed that in their locality, *"when women need to cook meals for their household members, they cannot directly access the on-farm eucalyptus tree even if they have legal right to do so. Rather, women need to get permission from their husbands. Or, they must wait for their husbands' willingness to have access to the eucalyptus tree".*

The above notions are aligned with what Mulinge (2013) presented. According to the author, in developing countries in general and in Africa in particular, women have less or no decision-making powers on their households' assets and property matters. This problem disproportionately affects women when household assets and properties are exposed to climate change hazards. For women, although highly restricted in using eucalyptus tree, there are expected changes in women's and children's roles of fuel wood collection, particularly in the better-off and medium income households. However, this role change results in the increase of women's and children's burden since they are also responsible for fetching water from streams.

The relation between husbands and wives pertaining to eucalyptus tree and energy access as well as consumption informs us those women do not decide or only rarely decide on eucalyptus tree and its byproducts. The how to use (whether in the form of charcoal or in wood form); when to use (maturity level of the tree or freedom to use the tree); and where to use (either for household consumption or for market) of eucalyptus tree remade on the hands of men's decisions. Thus, compared to women, men received significant benefits from the eucalyptus, whether it is in the form of wood or charcoal.

It was possible to comprehend that, on the one hand, men prefer to sale eucalyptus without cutting it down or processing it into charcoal or in any other form. This is mainly to save the cost of labor and time that they spend to process eucalyptus tree. Moreover, as an informant revealed, if eucalyptus tree is processed to charcoal, wives could share the benefits and men do not favor this way. On the other hand, women need eucalyptus tree

to be processed to charcoal rather than to sale it out without cutting it down. Although women receive negligible benefit from charcoal compared with men, they could have benefited in two ways. In the first place, women receive some amount of charcoal for consumption at home. Secondly, women benefit from eucalyptus tree by sending some amount of charcoal to the market and earn small cash to cover routine expenses. This would happen when only women assist their husbands to process charcoal.

There were households that have on-farm eucalyptus tree plantation but yet, exploiting the natural forest. These households used on-farm eucalyptus tree to generate cash rather than using it for household consumption. In these households, women and female children are responsible to search for fuel wood from the natural forest because women do not have access to eucalyptus tree. FGD participants and informants revealed that most female household heads are poor for they do not have access to land or they do not plow though they have land. This means, poor households do not have on-farm eucalyptus tree or only rarely manage the tree on their land, which implies that they have no or very few alternative energy sources. As a result, they used to collect fuel wood from the natural forest far away from their homesteads.

Informants espoused that in the past, there were more than nine natural forest sites in Gedamawit *kebele*. Now, only four sites (Godeb, Chana, Yinat, and Geser) are left and this situation made it difficult for most of the poor households to obtain fuel wood as easily as it was in the past. Moreover, in order to protect the remaining forest, local officials prohibited individuals to enter into the forests. This, in turn, left the poor households vulnerable to energy scarcity. It means that, collecting fuel wood has become a challenging task for women and female children from poor households. Women informants claimed that when they try to get into protected forests, they often fight with gatekeepers[7] who are employed and responsible to protect the forests. Therefore, it is not tough to imagine the worst scenario women and female children could face due to the shortage of energy. An informant (female, age 54) stated the concern at hand as follows:

> *Twenty years ago, we used to collect fuel wood from nearby homesteads. There was no shortage and no restriction to collect as well. However, since in the past two decades, we increasingly experienced difficulties and we used to travel 45 minutes on average; and now we have begun to travel about three hours to get a fuel wood from the mountain. In the future, we may not get a single wood and no alternative energy source in the surrounding sites. This is a backbreaking task that we and our children are struggling with.*

In various studies, it is proved that eucalyptus tree distracts its surrounding water resources, depletes the soil and destroys the biodiversity available up to the distances not less than 30 meters (Tilashwork *et al* 2013). Similarly, in the study area, the common problem to all women groups was scarcity of water and the challenge they face with getting water stream. Thus, no one can prove the problem other than the women in the study area who travel the unusual long distances from their homes to search for water streams. Informants expressed that, in the previous times their area was known of streams and they never walked more than five minutes to get water points and sources. These all arguments underscore that the burden on the women of Gedamawit *kebele* has been getting tripled as climate change emerged worse.

4.3.2 Animal Dung

Animal dung, locally called *kubet,* is an important domestic source of energy that households give priority. However, study participants claimed that it has been decreasing through time. Households use *kubet* during the rainy season although they prepared and stored during the dry season. During the rainy season, *kubet* cannot be easily dried due to the limited heat obtained from the sun. Woldeamlak (2005) stated that following the destruction of natural forest, animal dung has become one of the major domestic energy sources. In fact, Woldeamlak's argument depends on the number of livestock that households own. That is, if a household has larger number of cattle, it has a greater chance to get animal dung. Although

owning a relatively better number of cattle may enrich households with animal dung, as this study shows using animal dung as fuel has become increasingly difficult. This is because the number of cattle per household in the study *kebele* stands continuously decreasing for different reasons.

As indicated in Chart 1 above, 13.1% of the households responded that next to fuel wood, animal dung was the major source of energy. Similarly, in Chart 2 above 22.2% of female household heads used animal dung as important domestic energy sources compared with 4% of male household heads. This was due to the fact that female household heads decide by themselves on how to use the animal dung as they do not have conflict of interest with their husbands when they collect the dung from cattle field.

Of course, there were informants that denoted in the past, when livestock was abundant, animal dung served as energy source by women (women's priority and interest) while it served as fertilizer by men (men's priority and interest). This was because, women had been responsible for domestic activities. Hence, they want to fulfill their interest and be able to accomplish their domestic chores. Whereas, men's responsibilities were more related to agricultural activities; thus, they want to minimize farm and labor related costs such as chemical fertilizers by using indigenous fertilizer prepared from animal dung. This means that in the male headed households. it was less probable to use animal dung as a prioritized source of energy.

According to study participants, although husbands and wives had their own interests to use animal dung, in the past it was not a source of conflict between them. Overtime, there were cases of conflicts between husbands and wives on how to use animal dung because of its shortage. Shortage of animal dung was exacerbated by the fact that households were guided by agricultural experts that preparing compost-fertilizer from animal dung was a must to improve agricultural productivity. This had been further fueled by the decrease in grazing land, which increasingly become scarce and thus there was a decrease in the number of cattle per household.

From the above statement, we understand that the scarcity of animal dung was mainly attributed to the reduction in the number of livestock per household. Also, households hardly send their livestock to the field. This was accompanied by the shortage of pasture and several types of bushes and wild plants that were used as fodders for livestock. Informants also expressed that in the past twenty years, they had witnessed the decrease in the farmland per household.[8] Being attributed to population increase, land degradation (reduced cultivable land) and plantation of eucalyptus tree. The cumulative effect of these factors led households encroach on the common grazing lands and converted them to farm lands. This, in turn, forced the study communities to abandon a number of their cattle, which affected them to access animal dung. This eventually destructively affected women. The following table shows the falling trend of land size owned by households in the study area.

Table 4: The Diminishing Trend of Land Size per Household

Years	Average land size in hectare per households (HHs)		
	Better-off HHs	**Medium Income HHs**	**Poor HHs**
1990s-1999	4.0-4.5	3.0-4.0	1.0-2.0
2000-2005	2.0-3.0	1.0-1.5.0	0.0.5-1.0
2006-2010	2.0-3.0	0.75-1.0	0.0-0.5

Source: Sinan *Woreda* Agriculture and Rural Development Office (2012 Report)

Study participants indicated that the decrease in the number of cattle on the grazing field was not acceptable by the women without cattle. These categories of women depend on the dung they used to collect from the cattle-field for their energy. Particularly, poor households, especially women were the most negatively affected as they used to collect animal dung from the field, bake it and use it as a fuel, which is almost unbearable since few years. Even, better-off households who possessed a relatively large number of cattle have been in a difficult situation to access animal dung. Sometimes, spouses get into rubbings when wives try to use the dung for fuel without getting permission from their husbands. This is because men (husbands) have the authority not only on the dung (to be used to fertilize their land) but also on the households' cattle. Furthermore, failure to send cattle to the field was a blow, particularly to households and women who have no livestock of their own.

The reduction in the number of cattle per household presented above was implicitly or explicitly triggered by the influences of climate change. Meaning, the reduction in the cultivable land per households pushed the study community to encroach common grazing lands (*amaga maret*) for farming. Except few places (which was protected by the *kebele* administration), there was no grazing land that supports large number of cattle; thus, difficult for community members to send their cattle to the field. This was accompanied by the squeezing plots of grasses and several types of bushes and wild plants (example, aluma, *wulkiffa*, *qega* and *yabesha tsid*), which were used to serve as livestock feed. The overall result, damagingly affected the availability, accessibility and use pattern of animal dung in the study area, which mainly affected women (wives) compared with men (husbands).

4.3.3. Crop Straws and Residue

The other domestic energy source that informants give priority in terms of importance is *ageda* (crop straws) and *karmia* (crop residue). As shown in Chart 1 above, 12% of the total respondents used crop straws and/or crop residue as a source of domestic energy. This makes it a third important energy source next to animal dung. Moreover, as shown in Chart 2 above, compared with female household heads (constituted 7.4%), there were a greater number of male household heads (16.8%) that used crop straws and residue as a source of domestic energy. This was because farm and farm products were often controlled by men as men plow land and control most of the products. Also, female household heads did give their land for sharecroppers and have less chance to access crop straws and residue. Crop straws and residue serve households especially during dry season (*bega*) particularly following the harvesting season. Straws of bean, barley and wheat had been sources of energy in the study area, although now being replaced by maize. With the decline in productivity, the crops stated above were becoming less grown by the farmers. When farmers grow cereal crops, they used the straws as fodder to their livestock. This was following the scarcity of grazing land and lack of alternative fodder. With an introduction of maize in the area, maize's cane has become an emerging source of energy for those who used to produce maize.

The introduction of maize, in turn, was connected with the result of increment in local temperature. Until the recent past, only crops such as wheat, barley and bean were dominant. The straws and residues also served as roofs for hats. Although maize become a very recent history in the study area, FGD participants commonly shared the opinion that the introduction of maize into the area has created ample opportunities for most of the households because its product serves as food and its cane and residues (*qarmia*) serve as fuel energy when it dries. Collecting the cane of maize and its residues was women's and children's duty, while men were accountable for deciding on the usage of the main product.

4.3.4. Charcoal

Charcoal (locally known as *kesel)* was another source of domestic energy known in the study area. Informants noted that in the past, charcoal was not part of their source of domestic energy. It only served as a source of cash, especially for men. As indicated in Chart 1 above, insignificant number of households (0.5%) used charcoal as source of energy. Women, particularly do not use charcoal for household consumption since charcoal was mainly men's property and source of cash. In Chart 2 above, it was shown that none of the female respondents uses charcoal as a source of energy.

With the expansion of eucalyptus tree in the study area and due to lack of alternative energy sources, sometimes charcoal serves as an alternative domestic energy, particularly for better-off households. However, it was continued to be the major source of cash for most of the households. Unlike that of eucalyptus tree, if women assisted their husbands in processing charcoal, they were allowed to share the benefits from charcoal. That was, in cash as well as in kind, though they shared much less than that of their husbands. In relation to charcoal, men have the authority to allocate the amount of consumption at home, the amount wives could sale and get an income out of it. As a result, eucalyptus tree and charcoal (from eucalyptus tree) were major supplied items to the study area.

Moreover, as shown in the table below, to most of the better-off and to a few of the medium income groups, the source of fuel wood was changed from the indigenous natural forest to that of the privately managed trees (eucalyptus). The poor, who were female household heads and their children, have continued to encroach into the natural forest sites for collecting fuel wood.

Table 5: Summary of Indigenous Energy Types and Sources

Type of Indigenous Energy	**Seasonal Availability of Indigenous Energy**		**Source of Indigenous Energy by Type of HHs**		
	Dry Season (*Bega)*	**Rainy season (*Kiremt*)**	**Better-off HHs**	**Medium Income HHs**	**Poor HHs**
Fuel wood (*magedo*)	√	√	Private (eucalyptus)	Private/natural	Natural forest
Animal dung (*kubet*)	√	Less available	Private/field	Private/field	Field
Crop residue (*qarmia*)	√	Less available	Private	Private	private
Charcoal (*kesel*)		√	Private	Private	No/rarely use

Source: Field Research (September 16, 2017-June 2018)

The other important concern that should be raised in the study of gender-energy nexus was rural women's health conditions attributed to the smoke or fume of the fuel wood and dung. In the study area, although there was no study on the causes of some diseases, data received from Sinan District Health Office showed that Acute Respiratory Infections, Unspecified Eye Diseases and Unspecified Skin Infections were the three health problems that might be attributed to biomass energy use in their kitchen among the top-ten diseases of the area. According to health officers of Sinan district, most of the patients identified with the above diseases were women. In order to tackle the problems in the past three years, the Health Office of Sinan District has tried to distribute "improved" stoves known as *mirt* (literally

means "better") with fair price, but has never been successful. Moreover, the Water and Energy Office of Sinan District has been trying to provide energy services such as "improved energy efficient stoves" of various types. The attempts seem not to be successful for various reasons. The critical one was that most of the households were unable to afford the price of the improved energy efficient stoves.

5. Conclusion

The rural study communities depend on energy sources that had been devastated by natural calamities and anthropogenic forces. The problem was exacerbated by the shortage and unsustainable alternative energy sources. Neither electricity nor improved alternative energy sources were supplied to households in the study communities. In the relatively better-off-households (mainly male headed households), the source of fuel wood is eucalyptus tree. By this, there was a change in the roles, accessibility, and way to utilize fuel wood. For the "poor" households (mainly female headed households), natural forests were the major fuel wood sources. In this case, there was no change in the roles men and women could have played.

At intra-household level, there was gender differential interest in how to use the available energy sources. Women and female children were responsible for households' energy security. Thus, they were number one victim of the problems arising from climate change impacts in general and from shortage of energy in particular. Unless there was a solution, climate change deepens problems of energy. The burden on women and female children was getting triple when the climate change effects get stronger.

The commitment to execute and implement the relevant policies would enable to change the prevailing practices. For sustainable development to achieve its visions, there is a need to provide basic energy services and systems that could pave better ways to the study communities in general and to women in particular. It is also important to have a range of fuels and technologies that either substitute or at least support their energy needs. To reduce dependency of the study communities on the natural resources, who

further exploited the natural environment, it is commendable to make electricity available in the rural study communities and to provide other improved energy sources to rural households. This would align with the "green resilient economic development strategy" that Ethiopia has endorsed to implement.

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Notes

[1] This is a tree, the bark of which is used for making rope.
[2] This was a tree with edible green that grows during the rainy season.
[3] This is known as a wild olive tree.
[4] A tree the wood of which is used for making saddle frames and its leave can serve as fertilizer.
[5]Among the five FGDs, three have similar idea on household rankings based on the assets they owned.
[6] Share-croppers are men who can plow (healthy labor) and have at least an ox or a horse or more of these animals. Women do not receive land in the form of sharecropping as women in the area do not plow.
[7] These are individuals employed as guards to protect the forest sites from being cut down.
[8] Informants did not ignore the contribution of political factors such as land distribution of 1997 and the proclamation of 2003 on land registration and certification to the fragmentation of their lands.