ORIGINAL ARTICLE

The Gender Aspects of Agroforestry Practices in Maytemeko Watershed, Northwestern Ethiopia

Meseret Kassie Desta (Ph.D.)[1]

Abstract

This study was conducted to assess the gender aspect of agroforestry practices (AFPs) in terms of participation and benefit in northwest Ethiopia. An explanatory sequential research design of mixed method was employed to obtain and analyze the data required for the study. Household questionnaire survey which was collected from 138 randomly selected households, ethnographic observation and interview were used to collect data. The research result showed that though most women are implementing AFPs compared to their male counterparts, the number of trees and shrubs on farm plots are lower for women. At household level, women are taking highest responsibility to manage AFPs. It was also found that 40.3% (166.5 tons/year) of energy for cooking and heating is obtained from trees and shrubs grown in AFPs followed by natural forest wood sources (32.2% or 134 tons/ year). The majority of the respondents (56%) confirmed that women and girls are responsible for fuel wood collection from the natural forest areas. In contrast, for those households who obtained the fuel wood from AFPs, men are most responsible to prepare the fuel wood. An average time which was needed to collect a bundle of fuel wood from natural forest area was four times more than the time needed to collecting the same amount of fuel wood from AFPs. This indicated that AFP is playing a crucial role in reducing the burden of women and girls by reducing the time and labor spent for fuel collection. Generally, implementing AFP is not only used to save the natural forest cover, but it also has an implication in gender balance for fuel wood collection. Thus, stressing the multiple benefits of AFP, agricultural extension workers should encourage farmers to plant trees on their farm lands by recognzing the gender aspects as well.

Keywords: fuel wood, women, trees and shrubs, ethnography, natural forest

Introduction

Despite there are many attempts to define agroforestry, a comprehensively all agreed definition is still on process. However, different definitions are given by different scholars in different contexts. It is defined as the dynamic system of natural resource management which is grounded in ecology through which trees and/or shrubs are integrated into annual crops, grazing lands or any other landscapes (Kitalyi et al, 2013). Agroforestry

1 *Assistant Prof. of Natural Resource and Life Sciences, Department of Geography and Environmental studies, University of Gondar,*
Email: meseretkassie@gmail.com

DOI*:* https://dx.doi.org/10.4314/erjssh.v10i2.8

has been recognized by international policy treaties such as United Nations Framework Convention on Climate Change (UNFCCC) and the Convention of Biodiversity (CBD) for its contributions to sustainable development. This increased not only investment in its development (FAO, 2013), but also the need for further inquiry into inequities in its implementation. A few earlier studies pointed out how the use and access of agroforestry products has affected men and women differently (Hamilton, 2001; Kituyi, 2004), and more recent studies indicate that these are persistent problems (Kiptot et al., 2011; Glover et al., 2013; Fouladbash & Currie, 2015; Akter et al., 2017) despite of their geographical range and empirical depth emanating the urgent need of further studies.

With less than half of a hectare of natural forest remaining per person in most of the developing countries of the tropics, agroforestry practices have become more important for tree product supplies than forests (Madalcho & Tefera, 2016; Singh et al., 2016; Sahilu, 2017;Sahle et al., 2019). Indeed agroforestry has become the most important sustainable way of using the land for both improvement of livelihood of smallholder farmers (Kiptot et al., 2014; Smith et al., 2019; Lewa et al., 2019) and maintaining biodiversity for ecosystem health (Biodiversity International, 2016; Dupraz et al., 2019; Sahle et al., 2019). However, inequities in access to and management of agroforestry resources remain an inherent problem of the practice (Glover et al., 2013) in African context of high forest resource dependency.

At the heart of inequality in Africa's AFP management practices, and access of the products, today there are two key social trends. First, female farmers provide most of the labor for African food productions (Franzel, 1999; Kiptot et al., 2014). Second, women own only a small fraction of the world's farm land, and they receive less than 10% of agricultural extension services (Gabiso et al, 2015). This is despite the fact that women's knowledge have been crucial for plant domestication through continuous species selection for a long time (Köhlin et al., 2011; Meinzen-Dick, et al., 2019). Today men and women negotiate for trees which are grown in the farmlands in terms of tree species selection, tenure, use and access of tree products in developing countries under uneven and dynamic relations of power (Kiptot & Franzel, 2012; Edmunds, 2013; Gebrehiwot, Elbakidze, & Lidestav, 2018). It is also noticed that women have vital importance in the management of agroforestry practices because through this productive practice, they ensure the food consumption of the family besides generating income (Gonçalves, et al, 2021).

Ethiopia is one of the countries with high dependency of people on natural open access forest resources for timber and for non-timber products which creates a great burden on the national forest resource of the country (Kindu et al, 2013; Yeshaneh et al, 2013; Gitima et al, 2022). More than 90% of energy for cooking, and for heating in Ethiopia is obtained from biomass fuel (Mondal et al., 2018). Considering the current trends of forest use and land development, forecasting for forest resources in Ethiopia also predicts that an area of nine million hectare might become deforested between 2010 and 2030 for agricultural land. On the other hand, in the same period, annual fuel wood consumption may increase by 65% requiring more than 22 million tons of woody biomass which in turn may further exacerbate forest clearing (FRDE, 2011). The dominance dependency on bio-energy sources and households demand is projected to increase until the middle of the century (Yalew, 2022). This calls for greater attention to AFP implementation and utilization of the products from it both for the security of remaining natural forest endowments, and with an eye toward social equity and the human development potential of such a fast growing population.

Traditional agroforestry practices are very common in Ethiopia, and they are contributing

a significant share of timber and none timber products. Many studies have been conducted so far in areas of agroforestry in different parts of Ethiopia focusing on socioeconomic and environmental importance of agroforestry. For instance, Collier (2010), Duguma (2012) and Kassie (2017) documented the economic importance of agroforestry in South and central Ethiopia. Others like Gindaba et al (2005), Mekonnen et al (2006) and Manjur etal (2014)) studied effects of agroforestry on soil nutrient improvement. Negash (2013), Mekonnen et al (2014), and Worku (2017) also conducted research on biodiversity aspects of agroforestry in different parts of Ethiopia.

However, much has not been yet known regarding use, access and tenure of agroforestry in terms of gender role in Ethiopia. It was also noticed that studies of agroforestry systems which are focusing on indigenous communities, and on the roles of women in agroforestry have not been carried out (Gonçalves, et al, 2021). Therefore, the main purpose of this study is to fill this literature gap . This study particularly focuses on: 1) assessing the level of participation of women in agroforestry practices; 2) examining to what extent women are benefited from agroforestry practice in rural areas in terms of fuel wood collection and 3) exploring major challenges of women in implementing AFPs on their farm land.

2. Materials and Methods

2.1. Study site description

Maytemeko Watershed is located in Hulet Eju Enessie District (HEED), East Gojjam Administrative Zone, Amhara National Regional State, Northwestern highlands of Ethiopia. Geographically, it extends from 110 2' 30" to 110 6' 00" North and from 370 47' 0" to 370 51' 00" East (Figure 1). It is one of the head water tributaries of Abaya River which finally drains into Blue Nile River.

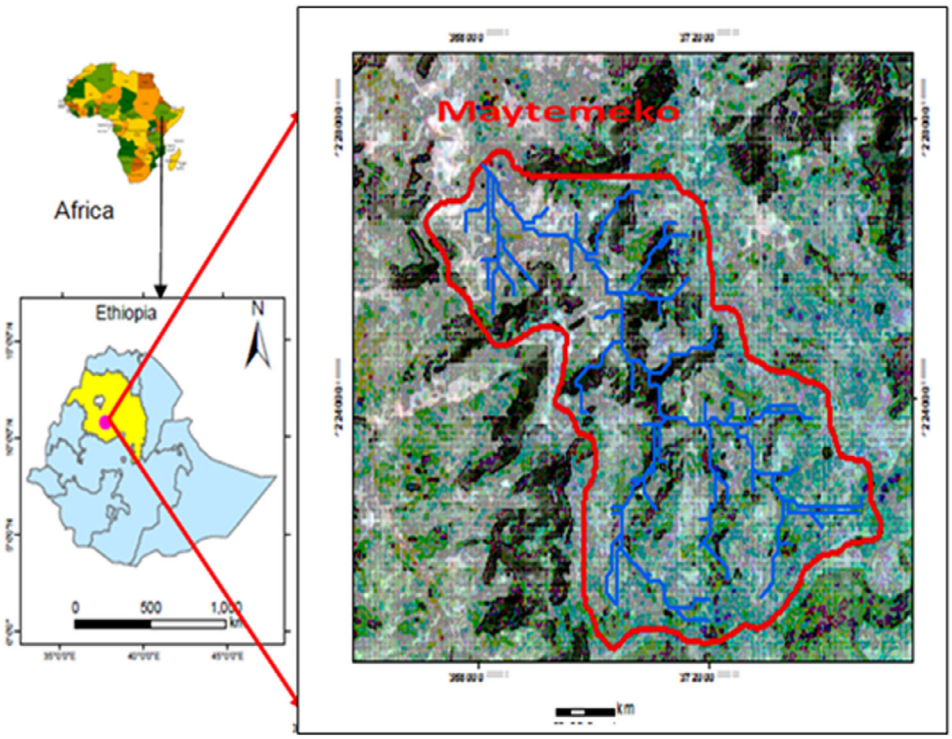

Figure 1: Location map od the study area

The area of the watershed is estimated to be 2819 hectares with varying land features ranging from level plateaus to steep slope escarpments. Similarly, the altitude of the watershed ranges from 1670-2400 m.a.s.l where the lowest altitude being at Abaya River, and the highest at the plateau in the south.

The mean annual rainfall is 1180 mm, and June, July and August are the main rainy months of the rainy season. There is also sporadic rain in April and May which farmers need for land preparation as well as for sowing annual crops that require long rainy seasons such as sorghum and millet (Hulet Eju Enesie District Agriculture, 2014).

The main economic activity of farmers in the study area is a mixed farming which blends crop production with animal husbandry. Combination of crop and livestock production on the same farm has evolved because of the inseparable nature of the food production sector from animal husbandry. In this mixed farming systems, livestock husbandry and crop production are complementary in that livestock are the source of power and manure while crop production provides residues for animal feed as it was described by Haileselassie et al. (2005).

The vegetation cover of the area is so sparse, and the available remnant forest resources in the area are concentrated only on steep slope areas, around churches and along river valleys. Since the remnant forest is highly degraded because of human interference for extraction of fuel wood, construction materials and cultivation land expansion, it cannot be considered as high forest according to FAO forest classification in Ethiopia. Thus, the forest type of the area is considered as woodland forest with crown coverage of > 20% (FAO, 2010).

The watershed was purposively selected to assess the gender aspect of AFPs in terms of women's participation, access and the benefits obtained from these practices since there are promising traditional AFPs in the watershed that have been never assessed before for their potential benefits for women in terms of fuel wood production. The common AFPs in the watershed are small scale wood lots, homegarden, alley cropping, boundary planting and scattered trees on farm.

2.2 Data collection

An explanatory sequential research design of a mixed method was employed to obtain and analyze the data required for the study. First the quantitative data which is collected using questionnaire survey was collected and analyzed followed by qualitative data of ethnographic observation and interview. In this case, the qualitative data was used to explain and back up the quantitative data as described by Creswell (2014).

To obtain the household data easily, the watershed was divided in to three kebele administrations (KAs)[1] which have watershed management plan that is being led by three experts (development agents) in areas of crop, forest and natural resource. These development agents have registered households at watershed level in each kebeles which is used as a sample frame. There are about 3229 households (2714 men and 515 women) who are living in the watershed. The sample size was calculated using the formula

1 Lowest government administrative unit/area next to district/ woreda

following Cocran (1977) as follow:

$$\frac{NZ^2pq}{D^2(N-1)+Z^2pq}$$

Where:
n = number of households selected for the questionnaire
N = total number of housing units (households) in the study watershed
z = value of z that corresponds with 95% confidence interval i.e. 1.96
p = proportion of the households to be included in the sample i.e. 10%
q = 1-p i.e. 0.9

D = degree of accuracy i.e. 0.05
Households were randomly selected from the lists of households in each KAs with proportional allocation of men and women headed by household heads. Thus, a total of 138 (116 male and 22 women households) were included in the survey.

To minimize the language barrier, the questionnaire was first prepared in English having both close and open-ended items, and it was translated to Amharic which is the local language in the study area. A pre-test was undertaken on 10 households which were excluded for the formal survey before the formal survey to validate the questionnaire. The feedbacks which were obtained from the pre-test were included, and a final questionnaire was duplicated. Data collectors who have diploma and above were trained on how they administer the questionnaire item by item. In the same way, face to face interview was used to administer the questionnaire since many of the household heads were believed to be illiterates.

The data which were collected by using the questionnaire survey was used to identify the level of participation of women and men in traditional AFPs, to estimate the amount of fuel used for cooking and heating that is found from different sources including the natural forest and agroforestry practices. The estimation fuel wood from different sources was done by using traditional measurement units like bundles for wood and basket for animal dung and crop residues based on the pre-test feed backs which was obtained prior to the formal survey. This was converted to standardized units of kilogram by weighing samples in market, and by taking the average from each type of sources. Moreover, the time which is required to collect a bundle of wood from agroforestry, and from natural forest areas was also calculated for comparison purpose which helped the researcher to investigate how AFPs are helping women in reducing their burden at household level.

Furthermore, ethnographic observation and interview were also employed for the qualitative data collection. The observation helped the researchers to get an insight on lived experiences of women in the watershed in terms of AFP implementation, fuel wood collection, gender based division between men and women from forest and agroforestry practices (Angrosino, 2007; Sangasubana, 2011). In-depth interview was also conducted to two purposely selected women household heads to assess major challenges they faced for agroforestry implementation, and to one other woman whose household head is male to discuss about their role in managing AFPs, and the right they have to control the products as a household member. Informal discussion with men household heads were also used to explore the view of men on power and control of AFP products.

2.3 Data Analysis

Statistical Package for Social Sciences (SPSS) of version 21 was used to analyze the quantitative data. Descriptive statistics was employed to analyze the participation of women in AFPs, fuel wood collection responsibilities, fuel energy sources and time spent for fuel wood collection from the natural forest, and from agroforestry practices. Moreover, the number of trees and shrubs, the time spent to collect fuel wood from AFP and natural forest, land holding size as well as active labor between men and women headed households were compared using an independent sample t-test. Since the quantitative result was used as a base, the data collected through ethnographic interview and observation were coded, and they were schematized based on the results from quantitative data and used to elaborate the quantitative results.

3. Results and Discussion

3.1. Women's participation in AFPs

An age old traditional AFPs are found in the watershed in both farm and grazing lands. In this study, the hosehold survey data indicated that most farmers (87%, N= 138) are participating in traditional AFPs on their farm lands. The result also showed that significant number of women (95.5%, N=22) are participating in AFPs in the watershedwhile their proportion is slightly lower than men (85.5%, N=116). Despite high rate of participation of women, the mean number of trees and shrubs on farm lands is smaller for women headed (7.2) households compared to men headed households (16.1). Similar result was reported by Kiptot et al. (2014) who indicated the degree of women's participation in fodder production and woodlots is fairly higher relative to men, but it is low as measured by the number of trees they plant on their farm land.

As justified by Duguma (2012), the low participation of women headed households in planting and protecting trees or farmlands might be related to the labor demand. . Moreover, farm size might also affect the number of trees and shrubs which are planted since the tenure issue is also gender related in many areas of the world (Doss et al., 2018; Meinzen-Dick et al., 2019).

On the other hand, among the users of AFPs of both women and men headed households, the majority of the respondents (47.3%) pointed out that women and girls are taking the highest responsibility of managing AFPs where as only 31.6% of the respondents pointed out that men and boys are responsible for the management of AFPs (Figure 2).

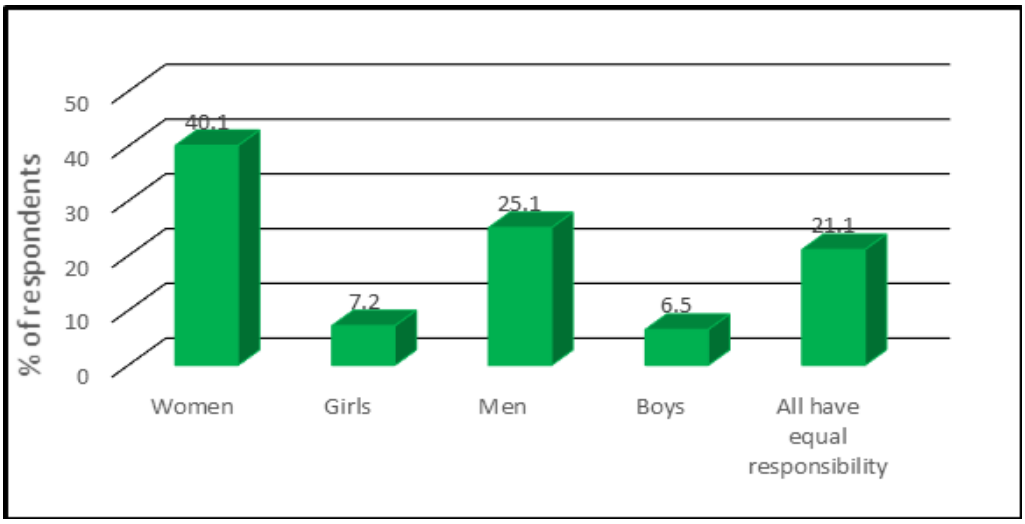

Figure 2. Respondents' view of agroforestry practice management among family members
Similarly, Gebrehiwot et al. (2018) found that women were the most responsible groups to manage homegarden AFPs in Southern parts of Ethiopia. The management activities include: planting seedlings, watering, weeding, fertilizing and collecting the products (Figure 3).

Figure 3. Women in agroforestry management in Maytemeko watershed.

According to interview results which were conducted to women, women are mostly involved in homegarden AFP management since they might stay long hours around home.

3.2 Agroforestry as wood energy source

It is pertinent to see the different sources of energy for cooking and for heating to have an insight about their respective contributions. Households which are in Maytemeko watershed obtained their energy for cooking and for heating from different sources. Nearby natural forests and shrub lands, AFPs (like boundary plants, homegarden, small-scale woodlots and scattered trees on farm), animal dung, crop residues and very small amount from other sources like charcoal and kerosene are identified sources. Similar research result was reported by Damte et al. (2012) and Yalew (2022) who indicated that Ethiopian households used various sources of fuel for cooking, but most of it comes from bio fuel. This creates great burden on the existing sparse forest resources of Ethiopia.

The mean annual fuel consumption of the sampled households which are located in Maytemeko Watershed was 3015.5 kg ranging from 771 to 5871 kg from all types of sources while the per capita fuel consumption was about 541 kg. Of the total fuel consumption (416.1 tons), the largest fuel wood amount (40.3%) was obtained from agroforestry trees and shrubs (Figure 4). Natural forests and shrub lands, animal dung, crop residues and other sources followed in decreasing order implying that highest contribution of bio fuel for energy production like in other most developing countries (Adkins et al., 2012; Yami et al., 2019). This result is in agreement with a research study which was reported by Mekonnen (2017) indicating the largest proportion of the households in rural Ethiopia obtained their fuel from trees and shrubs on farm lands. This exacerbates further forest degradation in one hand (Kindu et al., 2013; Niyongabo & Makonese, 2017; Mondal et al., 2018; Toth et al., 2019) and burning the useful soil nutrients that could be obtained from animal dung and crop residues on the other hand (Duguma & Hager, 2010; Shahsavari & Akbari, 2018).

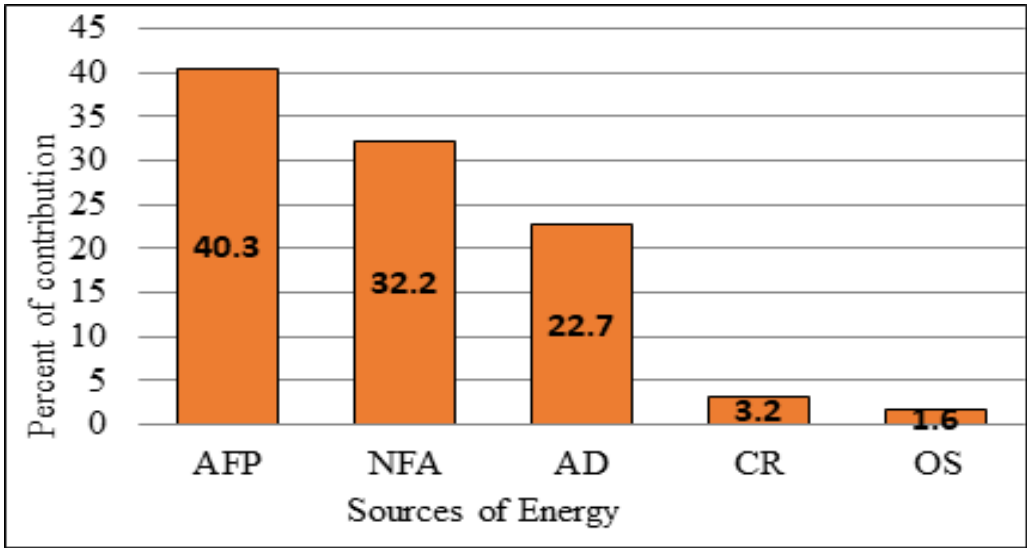

Figure 4. Proportion of annual fuel consumption by households from different sources, AFP= Agroforestry practices, NFA = Natural forest areas, AD = animal dung, CR = crop residues and OS = other sources

Comparing the two major wood sources of fuel (natural forests and agroforestry trees and shrubs) at the household level, the majorities (46%) of the households were using a mix of both the nearby natural forests and shrub and trees and from AFP for their fuel wood demand. However, about 37% of the households relied on only agroforestry trees and shrubs while the remaining 17% of the households were totally dependent on natural forest and shrub to satisfy their wood demand. From this, we can understand that the main source of fuel for farmers who are living in the watershed was trees and shrubs which are found from different components of agroforestry which might have significant implication to save the remaining patches of natural forests in the area. With an increasing demand for fuel energy, agroforestry will remain as best alternative energy source in developing countries to minimize the forest degradation (Duguma & Hager, 2010; Liyama et al., 2014) since most of these countries have no other sustainable energy sources (Geissler et al., 2013; Sharma et al., 2016; Pacudan & Hamdan, 2019; Yami et al., 2019, Yalew, 2022).

3.3. AFPs as reducing burden of women

3.3.1. Responsibility for fuel wood collection from Natural forest versus from AFPS

As mentioned earlier, considering households who are relying on natural forest and a mix of both AFPs and natural forest for their fuel wood demand, more than 56% of the respondents (N= 87) confirmed that women and girls are responsible for fuel wood collection from the nearby forest and shrub lands. Among household members, the burden of fuel wood collection is higher for girls than the boys (Figure 4). Similar result was also reported by Beyene et al. (2014) who indicated that the fuel and other resource collection burden is less likely for the boys than the girls in the Amhara National Regional State. In the same way,Kituyi (2004) also pointed out that the task of fuel wood collection was disproportionately left for women and children that had significant impact on their education and other development activities.

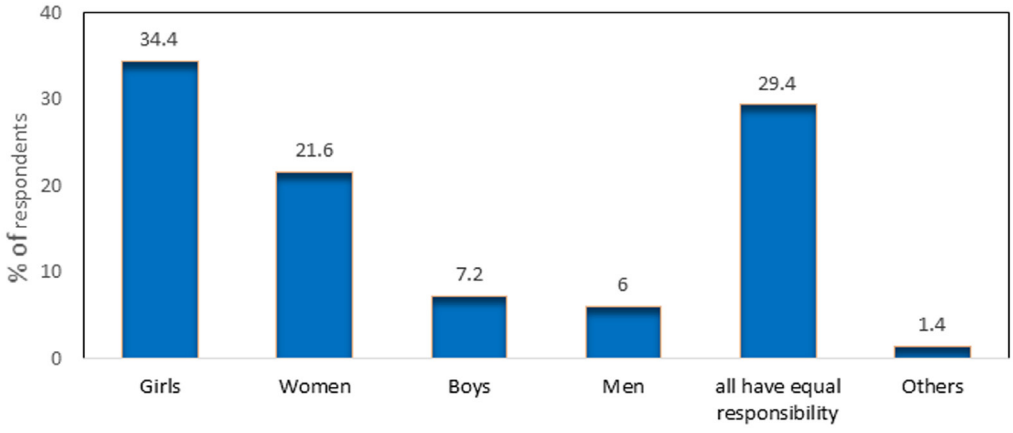

Figure5. Responsibility of household members for fuel wood collection from forests and shrub lands

On the other hand, in contrast to this result, Gebru & Bezu (2012) found that fathers and sons are more responsible to collect firewood from forests in the northern part of Tigray National Regional State . They explained that the forest area is very far away from home which may take up to 7 hours to travel and the area is adjacent to Afar National Regional State where other ethnic groups are living. Therefore, households fear risks of rape of their daughters and wives.

Girls who are attending their school usually collect the fire wood after school time or in weekend so that they will not have enough time to focus on their education outside the school. Sometimes, they are obliged by their parents to cancel their normal schooling time to collect fuel wood. Even little girls who are under the age of 10 (Figure 5A) are fuel wood collectors which is not common for boys in the same age. Even though the Sustainable Development Goals (SDG) has renewed its commitment to eradicate all forms of child labor by 2025 (International Labour Organization (ILO), 2017), in rural areas like Ethiopia still child labor is significantly seen with its gender discrepancies. Some authors argue that children can learn skill and socialized them when they work with their peers (Adonteng-Kissi, 2018). However, when work becomes exploitative and compromises the development of children and their school time, it should be considered as child abuse, and it must be avoided (Martin, 2013).

Figure 6 (A). Fuel wood collection from forest and 6 (B) from agroforestry trees and shrubs in Maytemeko Watershed (Photo by the author)

The burden on women and girls may be exacerbated with increasing deforestation since the forest cover will be pushed up to the marginal areas and farther away from home which increases the fuel wood collection time and labour. Consequently, children become essential for their parents with high work demand at the expense of schooling (Winkler-Dworak, 2004). Winkler-Dworak (2004) also further explained that such phenomenon subsequently worsens the process of human competence formation by reducing the time used for education.

In contrast to the above, of the households who are getting their fuel wood from AFPs and a mix of both sources, 91% of them (N = 114) confirmed that preparation and collection of fuel wood from agroforestry trees and shrubs is mostly carried out by men than women in Maytemeko watershed (figure 6B above). This might be related to the ownership/property right for planted trees and shrubs as it is stated below.

One of the women in Maytemeko pointed out that "*my husband is the most important decision maker to cut the tree for fuel wood purpose. Even sometimes I become scared of getting fuel wood from trees and shrubs grown on our farm land, and I prefer rather to go to the forest for free collection.*"

They (men) put a divide line that restricts women not to control big trees for timber and fuel production as well while they allow them to collect and sale leaves of Rhamnus prinoides and fruits for selling and for buying other consumable goods for the household.

3.3.2 Time needed to collect fuel from natural forest and AFPS

The household survey indicated that the average time which is needed to collect 30 kg (one bundle) of fuel wood from natural forest, and from shrub lands was about four hours whereas for those households who used their own trees and shrubs from AFPs was about one hour to the same amount of fuel wood. The average fuel wood amount from the natural forest and shrub was about 1542 kg (for households who depend on these sources only). This needs about 206 hours for collection. Assuming the annual working hours at the national level which is about 1,520 hours[2] based on civil servants (eight hours/day) work load excluding public holidays and annual allowable leave, the fuel wood collection would amount to approximately 9% of a person.

The above data illustrates that significantly much amount of time is consumed by fuel wood collection from the natural forests. A very similar result was reported by Gebru & Bezu (2012) who found that on average, the time spent to collect fire wood from the forest is about 9 hours which is even greater than the current study. The difference might be related to the distance of the forest area from home. Thus, an increase in time for collecting firewood is due to shortages in the nearby area as this fact was also confirmed by Damte et al. (2012). With the current deforestation rate in the watershed (Desta, 2015), the probability of pushing the fuel wood source to the hills and steep slope areas may also probably increase the time of fuel wood collection for women in the near future.
On the other hand, for those households who are using their own trees and shrubs from AFPs as source of fuel wood, the annual time spent was about 32.4 hours instead of 130 hours to collect and prepare the same amount of fuel. This means that collecting fuel wood from the natural forests took more than four times longer than collecting fuel wood

from agroforestry trees and shrubs. Almost the same result was reported by Mugo (1999) in Kenya who found that the annual time spent to collect fire wood from far away forests was about 130 hours compared with 36 hours for collecting from their own farms.

This shows that trees and shrubs which are grown in agroforestry practices can play a significant role not only to conserve the natural forests but also to minimize the work load of women through labor division among the household members for fuel collection, and it reduce the time spent for collection. Agroforestry offers many contributions in making fuel wood collection easier and more convenient for households by reducing labor wastages (Mekonnen et al., 2017; Yami et al., 2019). This in turn, could have impact on other sectors of development. In agreement with this idea, FAO (2013) pointed out that combining agricultural crop and fuel wood production through AFPs saves woodland trees and minimizes labor waste especially for women who traditionally collect wood.

3.4. Challenges of women in AFP implementation

Agroforestry practices required labor from planting to harvesting of the products. The lower number of trees and shrubs on farm lands of women headed households compared to men counter parts might be also related to the labor demand. Significance difference was observed ($p=0.01$, $t= -2.5$) between women and men headed households where the average active labor for the former is about 2.4 while for the later is about 3.1. Interview which was conducted to women household heads also indicated that labor shortage is affecting their tree planting, and their managing activity since this needs day to day follow ups. This might be attributed to most women headed households which may be the result of divorce where they gone out from their home to prepare for another marriage so that they left their children with their fathers.

Similarly, farm size might also affect the use of AFPs since many of the households considered that AFPs compete for the annual crop production for household demand as stated by Gao et al. (2013). The household survey indicated that there is significant difference in land holding size between men and women ($p=0.03$, $t=-2.2$) with mean land holding size of women (0.9 ha) and men (1.2 ha). This study is in agreement with the study which was done in Vietnam that indicates land and labor are the most important constraints of agroforestry implementation for female headed households (Catacutan & Naz, 2015).

As indicated from the analysis, households also prioritized major challenges that limit them not to plant trees and shrubs on their farm land. Among the major problems, land shortage was repeatedly mentioned with different proportion by men and women (Figure 6). The proportion of women prioritized land short and free grazing as the main challenge is higher compared to the men counterparts while land tenure security was prioritized as a challenge by men than women.

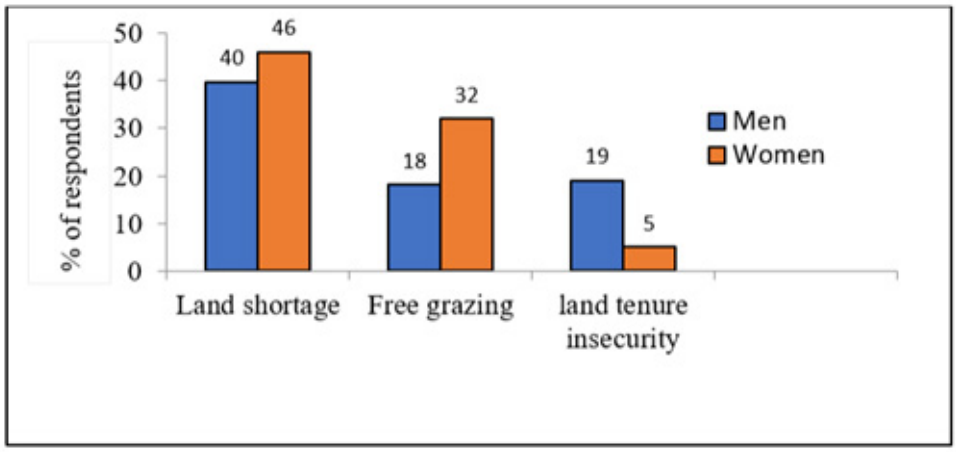

Figure 7. Three main problems prioritized by men and women as challenge of AFP implementation

On the other hand, when a woman becomes the head of the household, she might be frustrated to plant trees due to theft of fruits as well as wood products and free grazing domestic animals which is not mostly seen for male headed households. This might be the patriarchal thinking which is deep rooted in the society which leads to loss of property that is owned by women.

A widowed woman pointed out that, "*No one is respecting my tree gardens after my husband died so that I lost most of the trees which were planted on my farm plot. People cut my own trees and shrub products without asking me permission." She also added that "since free grazing is very common, cattle simply enter to my garden and destroy my trees and shrubs*."

In contrast to the above idea, a man who was the household head was asked about the use of his tree products by another person and he said that "*if someone wanted to use/ cut tree products from my woodlot, he has to get permission from me before he cut the tree. If he cut a single tree without my consent, this will lead to unnecessary clash between us."* He also added that, *"My wife may not be even consulted to allow someone to use their tree products."*

The above two cases showed us the gender role on the use and utilization of AFPs which significantly disregards women decision making role as a household head and/or being a wife in the household. This result agrees with the research which was done by Catacutan & Naz (2015) who explained that decision making in agroforestry is gendered and men are the most decision makers on the selection of tree species and utilization of AFP products in Vietnam. Likewise, Toth et al. (2019) also reported that female headed households are disadvantaged when they are using on individual plots in Malawi, and they suggested that promoting communal woodlots in areas with high numbers of female-headed households by considering weak tenure scenarios while individual woodlots within broader agroforestry may be preferred for male-headed households. Similarly, Gebrehiwot et al. (2018) indicated that though traditional diversified homegarden AFPs had great economic benefits for rural women and nutritional values for the family, these days they

are converted into Khat (*Catha edullis)* monoculture without the consent of women which leads to total control of production and the income by men. Such kind of activities will widen the gender gap over the economic control. Recent reports by World Economic Forum (WEF) also indicated that at global level, the gender gap in economy is significantly high as compared to other parameters (WEF, 2019).

Conclusion

Taking gender into consideration in relation to AFPs matters on how, why and where men and women access, use and manage AFPs differs. The number of women households who are participating in AFPs is high in the study area. However, the total number of trees and shrubs for women household heads is lower than the male counter parts. This is most likely related to low number of active labor, land holding size as well as the cultural undermining thinking of the society for women. This needs arranging incentive mechanisms through direct employing the labor forece for these women, looking equity aspects for land and educating farmers about gender equity. The study also signifies that women are playing a critical role in the management process of AFP which should be encouraged not only to satisfy their fuel demand and save the natural forest but also to improve the nutritional contribution of these practices. Women's high labor input for AFPs, if accompanied by a more inclusive decision-making process, would bring the positive outcomes in the agricultural sector (Yami et al., 2019) which in turn satisfies many of the SDGs including gender equity, eradication of poverty, climate change and so on.

Agroforestry practices play significant roles in terms of fuel wood provision which has different implication for men and women. Fuel wood collection is considered as women's responsibility in many cases. However, this study showed us different views in this regard when it is collected from AFPs. Though the responsibility for fuel collection from forest area is still mostly left for women, men in contrast play the key role for fuel wood preparation from AFPs. This significantly contributes for women to use their remaining time for other development activities including education and food production.

Though the government of Ethiopia is striving for sustainable way of energy provision (Geissler, 2013; Mondal et al., 2018; Yalew, 2022), this may take longer times (Mekonnen et al., 2017). Therefore, in the absence of alternative technologies such as electricity for cooking and heating, rural households in Ethiopia are likely to continue their dependence on traditional biomass sources of energy. Thus, agroforestry should be the best choice to save the natural forest as fuel source in addition to its gender role importance. It should be also pertinent to introduce other energy saving stoves in the country to reduce the current fuel consumption. Lastly, AFPs which are an age-old practice in the watershed should be supported by agricultural extension workers in consulting the indigenous people for better production and for environmental protection.

Acknowledgment: The Author would like to thank Austrian Development Cooperation APPEAR program for its financial support during first phase data collection and University of Michigan African Presidential (UMAPS) program for its financial support during phase two data collection and write up. My special thank goes to Prof. Rebecca Hardin.

References

Adkins, E., Oppelstrup, K., & Modi, V. (2012). Rural household energy consumption in the millennium villages in Sub-Saharan Africa. *Energy for Sustainable Development*, *16*(3), 249–259. https://doi.org/10.1016/j.esd.2012.04.003

Adonteng-Kissi, O. (2018). Parental perceptions of child labour and human rights: A comparative study of rural and urban Ghana. *Child Abuse and Neglect*, *84*(July), 34–44. https://doi.org/10.1016/j.chiabu.2018.07.017

Akter, S., Rutsaert, P., Luis, J., Htwe, N. M., San, S. S., Raharjo, B., & Pustika, A. (2017). Women's empowerment and gender equity in agriculture: A different perspective from Southeast Asia. *Food Policy*, *69*, 270–279. https://doi.org/10.1016/j.foodpol.2017.05.003

Angrosino, M. (2007). *Doing Ethnographic and Observational Research*. SAGE.

Beyene, A. D., Mekonnen, A., & Gebreegziabher, Z. (2014). Natural resource collection and children ' s literacy. In *Environment for development* (No. 14–18; Issue August).

Catacutan, D., & Naz, F. (2015). Gender roles, decision-making and challenges to agroforestry adoption in Northwest Vietnam. *International Forestry Review*, *17*(4), 22–32. https://doi.org/10.1505/146554815816086381

Cocran, W. (1977). *Sampling techniques* (3rd ed.). John Wiley and Sons.

Collier, P.(2010). Economic evaluation of coffee-enset - based agroforestry practice in Yirgachefe Woreda , Ethiopia : comparative analysis with parkland agroforestry practice. *American Journal of Botany*, *1*(3), 8–18.

Creswell, J. (2014). *A concise introduction to mixed methods research*. Thousand Oaks (CA), SAGE.

Damte, A., Koch, S. F., & Mekonnen, A. (2012). Coping with fuelwood scarcity household responses in rural Ethiopia. In *Environment for Development: Vol. DP 12-01* (No. 12–01; Issue January).

Desta, M. K. (2015). *Land Use / Cover Changes and the Role of Agroforestry Practices in Reducing Deforestation and Improving Livelihoods of Smallholders in Maytemeko Watershed , Northwest Ethiopia Dissertation for obtaining a doctorate degree at the University of Natural Reso. March*.

Doss, C., Meinzen-Dick, R., Quisumbing, A., & Theis, S. (2018). Women in agriculture: Four myths. *Global Food Security*, *16*(July 2017), 69–74. https://doi.org/10.1016/j.gfs.2017.10.001

Duguma, L. A. (2012). Financial analysis of agroforestry land uses and its implications for smallholder farmers livelihood improvement in Ethiopia. *Agroforestry Systems*, *87*(1), 217–231. https://doi.org/10.1007/s10457-012-9537-1

Duguma, L. A., & Hager, H. (2010). Fuelwood Use and its Impacts on Food Crop Production and Nutrient Transport from Forests in the Highlands of Ethiopia. *World Food System- a Contribution from Europe*.

Dupraz, C. (2019). A 3D Agroforestry Model for Integrating Dynamic Tree–Crop Interactions. *Sustainability*, *11*(8), 2293. https://doi.org/10.3390/su11082293

Edmunds, D. (2013). *Gender and agroforestry – ownership of trees in the context of climate change (David Edmunds , What does it mean to say that tree tenure is " gendered "? February*.

FAO. (2010). *G lobal forest resources assessment country report, Ethiopia*.

FAO. (2013). *Advancing agroforestry on the policy agenda: Aguide to decission-makers. Agroforestry working paper* (No. 1; Issue 1).

Fouladbash, L., & Currie, W. S. (2015). Agroforestry in Liberia: household practices, perceptions and livelihood benefits. *Agroforestry Systems*, *89*(2), 247–266. https://doi.org/10.1007/s10457-014-9763-9

Franzel, S. (1999). Socioeconomic factors affecting the adoption potential of improved tree fallows in Africa. *Agroforestry Systems*, *47*, 305–321.

FRDE. (2011). *The pathe to sustainable development: Ethiopia's climate- resilient green economy strategy* (p. 16). FDRE.

Gao, L., Xu, H., Bi, H., Xi, W., Bao, B., Wang, X., Bi, C., & Chang, Y. (2013). Intercropping Competition between Apple Trees and Crops in Agroforestry Systems on the Loess Plateau of China. *PLoS ONE*, *8*(7), 1–8. https://doi.org/10.1371/journal.pone.0070739

Gebrehiwot, M., Elbakidze, M., & Lidestav, G. (2018). Gender relations in changing agroforestry homegardens in rural Ethiopia. *Journal of Rural Studies*, *61*(October 2017), 197–205. https://doi.org/10.1016/j.jrurstud.2018.05.009

Gebru, B., & Bezu, S. (2012). *Environmental Resource Collection versus Children ' s Schooling : Evidence from Tigray ,* (No. 007; Issue March).

Geissler, S., Hagauer, D., Horst, A., Krause, M., & Sutcliffe, P. (2013). *Biomass energy strategy Ethiopia*. www.euei-pdf.org/…/Ethiopia_Biomass_Energy_Strategy

Gindaba, J., Rozanov, A., & Negash, L. (2005). Trees on farms and their contribution to soil fertility parameters in Badessa, eastern Ethiopia. *Biology and Fertility of Soils*, *42*(1), 66–71. https://doi.org/10.1007/s00374-005-0859-2

Gitima, G, Teshome, M, Kassie & Jakubus, M (2022). Spatiotemporal Land Use and Cover Changes across Agro-ecologies and Slope Gradients Using Geospatial Technologies in Zoa watershed, Southwest Ethiopia. *Heliyon, Vol 8, issue 8*

Glover, E. K., Ahmed, H. B., & Glover, M. K. (2013). Analysis of Socio-Economic Conditions Influencing Adoption of Agroforestry Practices. *International Journal of A Griculture and Forestry*, *2013*(4), 178–184. https://doi.org/10.5923/j.ijaf.20130304.09

Gonçalves, C.d.B.Q, Schlindwein, M.M & Martinelli, G.d.C. (2021). Agroforestry Systems: A Systematic Review Focusing on Traditional Indigenous Practices, Food and Nutrition Security, Economic Viability, and the Role of Women. Sustainability, 13, 11397. https:// doi.org/10.3390/su132011397

Hulet Eju Enesie District Agriculture (2014). General facts of Hulet Eju Enesie District, unpublished source.

Hamilton, P. (2001). Shady Practices: Agroforestry and Gender Politics in The Gambia, by Richard A. Schroeder. Berkeley: University of California Press (1999).

Reviewed by Peter Hamilton. *Journal of Political Ecology*, *8*(1), 10. https://doi.org/10.2458/v8i1.21583

International, B. (2016). *Mainstreaming Agrobiodiversity in Sustainable Food Systems Scientific Foundations for an Agrobiodiversity Index_Summary*. www.bioversityinternational.org

International Labour Organization (ILO). (2017). *Global estimates of child labour: Results and trends, 2012-2016*. https://doi.org/10.1016/j.soilbio.2011.02.006

Kassie, G. W. (2017). Agroforestry and farm income diversification : synergy or trade - off ? The case of Ethiopia. *Environmental Systems Research*. https://doi.org/10.1186/s40068-017-0085-6

Kindu, M., Schneider, T., Teketay, D., & Knoke, T. (2013). Land Use/land cover change analysis using object-based classification approach in Munessa-Shashemene landscape of the Ethiopian highlands. *Remote Sensing*, *5*(5), 2411–2435. https://doi.org/10.3390/rs5052411

Kiptot, E., Group, C., Agricu, I., Franzel, S., Agroforestry, W., & Gr, C. (2011). *Gender and Agroforestry in Africa : Are Women Participating ? Evelyne Kiptot and Steven Franzel* (No. 13).

Kiptot, Evelyne, & Franzel, S. (2012). Gender and agroforestry in Africa: A review of women's participation. *Agroforestry Systems*, *84*(1), 35–58. https://doi.org/10.1007/s10457-011-9419-y

Kiptot, Evelyne, Franzel, S., & Degrande, A. (2014). Gender, agroforestry and food security in Africa. *Current Opinion in Environmental Sustainability*, *6*(1), 104–109. https://doi.org/10.1016/j.cosust.2013.10.019

Kituyi, E. (2004). Towards sustainable production and use of charcoal in Kenya: exploring the potential in life cycle management approach. *Journal of Cleaner Production*, *12*(8–10), 1047–1057. https://doi.org/10.1016/j.jclepro.2004.02.011

Köhlin, G., Sills, E. O., Pattanayak, S. K., & Wilfong, C. (2011). Energy , Gender and Development. What are the Linkages? Where is the Evidence? In *World Bank Policy Research Working Paper* (Issue 125). http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1931364

Length, F. (2015). *Women in Home garden Agro forestry system of*. *5*(4), 103–111.

Lewa, K. K., Chivatsi, W. S., Saha, H. M., Muinga, R. W., & Lewa, K. K. (2019). *Maize* –

Cassava Intercropping : An Effort to Increase Food and Feed Security and Incomes in Coastal Lowland Kenya Maize – Cassava Intercropping : An E ff ort to Increase Food and Feed Security and Incomes in Coastal Lowland Kenya. *8325*. https://doi.org/10.1080/00128325.2019.1659214

Liyama, M., Henry, N., Dobie, P., Mary, N., Ndegwa, G., & Jamnadass, R. (2014). The potential of agroforestry in provision of sustainable woodfuel in Sub-Saharan Africa. *Current Opionion in Environmetal Sustainability*, *6*, 138–147.

Manjur, B., Abebe, T., & Abdulkadir, A. (2014). Effects of scattered F . albida (Del) and C . macrostachyus (Lam) tree species on key soil physicochemical properties and grain yield of Maize (Zea Mays): a case study at umbulo Wacho watershed , southern Ethiopia. *Wudpeckers J.Agric. Resear.*, *3*(3), 63–73.

Martin, M. (2013). Child labour: parameters, developmental implications, causes and consequences. *Contemporary Social Science*, *8*(2), 156–165. https://doi.org/10.1080/21582041.2012.751501

Meinzen-Dick, R., Quisumbing, A., Doss, C., & Theis, S. (2019). Women's land rights as a pathway to poverty reduction: Framework and review of available evidence. *Agricultural Systems*, *172*(November 2017), 72–82. https://doi.org/10.1016/j.agsy.2017.10.009

Mekonnen, D., Bryan, E., Alemu, T., & Ringler, C. (2017). Food versus fuel: examining tradeoffs in the allocation of biomass energy sources to domestic and productive uses in Ethiopia. *Agricultural Economics (United Kingdom)*, *48*(4), 425–435. https://doi.org/10.1111/agec.12344

Mekonnen, E. L., Asfaw, Z., & Zewudie, S. (2014). Plant species diversity of homegarden agroforestry in. *International Journal of Biodiversity and Conservation*, *6*(4), 301–307. https://doi.org/10.5897/IJBC2014.0677

Mekonnen, K., Yohannes, T., Glatzel, G., & Amha, Y. (2006). Performance of eight tree species in the highland Vertisols of central Ethiopia: growth, foliage nutrient concentration and effect on soil chemical properties. *New Forests*, *32*(3), 285–298. https://doi.org/10.1007/s11056-006-9003-x

Mondal, M. A. H., Bryan, E., Ringler, C., Mekonnen, D., & Rosegrant, M. (2018). Ethiopian energy status and demand scenarios: Prospects to improve energy efficiency and mitigate GHG emissions. *Energy*. https://doi.org/10.1016/j.energy.2018.02.067

Mugo, F. W. (1999). *The Effects of Fuelwood Demand and Supply Characteristics, Land Factors, and Gender Roles on Tree Planting and Fuelwood Availability in Highly Populated Rural Areas of Kenya*. Cornell University.

Negash, M. (2013). *The indigenous agroforestry systems of the south-eastern Rift Valley escarpment, Ethiopia: Their biodiversity, carbon stocks, and litterfall*. University of Helsinki.

Niyongabo, P., & Makonese, T. (2017). *Analysis of Household Energy Uses in Mubuga Informal*. *57*, 38–46. https://doi.org/10.1080/09709274.2017.1311653

Pacudan, R., & Hamdan, M. (2019). Electricity tariff reforms, welfare impacts, and energy poverty implications. *Energy Policy*, *132*(June), 332–343. https://doi.org/10.1016/j.enpol.2019.05.033

Sahilu, M. G. (2017). *Agroforestry homegardens in Ethiopia : rural livelihoods in transition*. Swedish University of Agricultural Sciences.

Sahle, M., Saito, O., Fürst, C., Demissew, S., & Yeshitela, K. (2019). Future land use management effects on ecosystem services under different scenarios in the Wabe River catchment of Gurage Mountain chain landscape, Ethiopia. *Sustainability Science*, *14*(1), 175–190. https://doi.org/10.1007/s11625-018-0585-y

Sangasubana, N. (2011). How to conduct ethnographic research. *Qualitative Report*, *16*(2), 567–573.

Shahsavari, A., & Akbari, M. (2018). Potential of solar energy in developing countries for reducing energy-related emissions. *Renewable and Sustainable Energy Reviews*, *90*(June 2017), 275–291. https://doi.org/10.1016/j.rser.2018.03.065

Smith Dumont, E., Gassner, A., Agaba, G., Nansamba, R., & Sinclair, F. (2019). The utility of farmer ranking of tree attributes for selecting companion trees in coffee production systems. *Agroforestry Systems*, *93*(4), 1469–1483. https://doi.org/10.1007/s10457-018-0257-z

Toth, G. G., Nair, P. K. R., Jacobson, M., Widyaningsih, Y., & Duffy, C. P. (2019). Malawi's energy needs and agroforestry: Impact of woodlots on fuelwood sales. *Energy for Sustainable Development*, *50*, 101–108. https://doi.org/10.1016/j.esd.2019.02.006

WEF. (2019). *Global Gender Gap Report 2020*. https://www.weforum.org/reports/gender-gap-2020-report-100-years-pay-equality

Winkler-dworak, M. (2004). Food security , fertility differentials and land degradation in sub-Saharan Africa : a dynamic framework. *Vienna Yearbook of Population Research*, *2*(1), 227–252.

Worku, M. (2017). Woody Species Diversity of Parkland Agroforestry in Ethiopia Global Journal of Technology and Woody Species Diversity of Parkland Agroforestry in Ethiopia. *Global J Technol Optim*, *8*(2). https://doi.org/10.4172/2229-8711.1000218

Yalew,A.W (2022).The Ethiopian energy sector and its implications for the SDGs and modeling.*Renewableand sustainable energy transition 2 (2022)10018*

Yami, M., Haddis, E., Birhane, E. & Kidu, G. (2019). Climate-Smart Agriculture Enhancing Resilient Agricultural Systems, Landscapes, and Livelihoods in Ethiopia and Beyond Kiros. In B. Meles Kiros Hadgu, Bishaw, Badege Iiyama, Miyuki Emiru, Negussie, Aklilu Davis, Caryn M. Birhane, and Bryan (Ed.), *Building*

gender-sensitive climate-smart agriculture approaches for sustainable food-energy systems. (pp. 203–210). World Agroforestry Center.

Yeshaneh, E., Wagner, W., Exner-kittridge, M., & Legesse, D. (2013). Identifying Land Use / Cover Dynamics in the Koga Catchment , Ethiopia , from Multi-Scale Data , and Implications for Environmental Change. ISPRS International Journal of Geo-Information, 2, 302–323. https://doi.org/10.3390/ijgi2020302

Zomer, R. ., Trabucco, A., Coe, R., & Place, F. (2009). *Trees on farm: analysis of global extent and geographical patterns ofagroforestry* (No. 89).