Addis Ababa University

Coffee shade trees:-Current status, Phenology, Management practices and Threats in Kochere Woreda, Gedeo Zone, SNNPR, Ethiopia

Ahmed Agmas Mussa

Addis Ababa, Ethiopia

September, 2021

Addis Ababa University

Coffee shade trees:-Current status, Phenology, Management practices and Threats in Kochere Woreda, Gedeo zone, SNNPR, Ethiopia.

Ahmed Agmas Mussa

AThesis Presented to the School of Graduate Studies of the Addis Ababa University in Partial Fulfillment of the Requirements for the MSC in Biology(Summer-In-Service).

Addis Ababa University

Addis Ababa, Ethiopia

September,2021

ADDIS ABABA UNIVERSITY
GRADUATE PROGRAMMES

This is to certify that the thesis prepared by Ahmed Agamas Mussa entitled Coffee Shade Trees:-Current status,Phenology,Management practices and Threats in Kochere Woreda Geadeo Zone SNNPR, Ethiopia and a thesis presented to the school of graduate studies of the Addis Ababa University in partial fulfillment of the requirements for the MSC in Biology(Summer-In-Service) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Names and signatures of the examining board:

Name	Signature	Date
1 Prof.Tamrat Bekele (Examiner)	_____	_____
2 Prof.Legesse Negash(Advisor)	_____	_____
1. _____(Chairman)	_____	_____

ABSTRACT

This study was conducted in Kochere woreda,Gedeo Zone,SNNPR, Ethiopia. The aim of this study was to identify the most common and important shade tree species,current status, phenology and threats and to document farmer's perspectives on the environmental and socio economic benefits of the shade trees on coffee production systems. The data were collected through structured and semi structured interview,questionnaire,and field observations. Data were analyzed using preference ranking following (Martin,1995),direct matrix ranking following (Cotton,1996) and appropriate percentage were used. Wherever descriptive statistics were also computed so as to summarize the essence of the data. Six most common coffee shade tree species were selected in the study area. Farmers preferred these shade tree species in their coffee plantation due to their shade providing and soil fertility improvement and also based on their multipurpose values. Coffees under shade increase the yield and size of coffee beans however under sun growing,cup quality and coffee bean size decrease. Agroforestry practice was takes place deliberately the production of woody and non woody crops in the same field of land. Removing of weed,inter cropping,protecting natural regeneration plants,looping of side branches as well as pollarding and debarking were constitute the major management practices. People highly exploited in the natural environment as the source of their lively hoods,it promote negative effects on plant distribution. Regarding to threats of coffee shade tree informants clearly put their worries about the future prospective of these shade trees under the existing dynamics .This research identifies that the rapid population growth in the study area as a potential threat to the sustainability of coffee shade tree.

KEY WORDS:- *Millettia ferruginea,Albizia schimperiana,Acacia* abyssinica,*Crothon macrosthys,Cordia africana,Ficus vasta* and Agroforestry.

ACKNOWLEDGEMENT

First of all I would like to thank my Almighty God Allah for the completion of this MSC degree program through strong internal and external challenges. Alhamdulilahi rebil alemin.

I would like to thank my advisor Prof.Legesse Negash who guided me to such splendid achievement. I am very much happy to have him as a promoter,his critical and constructive comments.Ministry of education(MOE)and Addis Ababa University also acknowledged for their financial support and also I acknowledged department of Zoological science. I have a great thank all the informants of the farmers and the man who participate this research who gave precious time and energy and thanks goes to my beloved brother Yasin Omer for his overall envolvement and I would like to thank my best friend Birhanu Hassen for his consistent advice,support and encouragement. I have appreciations for the kochere woreda agricultural office for their support of documented materials. At last I would like to thank Hanchebe kebele administer ato Nigatu he has strongly participate by translating languages and he has as a guidance during field observation and he adjust time and space at the time of group discussion.

TABLE OF CONTENTS

Contents Page

LIST OF FIGURES

List of Figures Page

LIST OF TABLES

List of Table Page

LIST OF APPENDICES

Appendices **Page**

1. INTRODUCTION

1.1 Back ground of the study

Coffee naturally occurs as under story shrubs or small tree in the afromontaine rain forest and coffee production is associated with other shade trees that provide shade. Shade trees provide several socio economic and ecological benefits.several studies have demonstrated the multiple uses of coffee shade trees and their role in micro climate regulation and prevention of coffee plants from damages by frost or other extreme environmental conditions (Lin,2007). Biodiversity conservation (Sonto-Pinto et al,2000,Perfecto et al,2005),soil fertility improvement (Yadessa Abebe *et al*,2001,Kimemia,2007,Muleta Driba *et al*,2008,Perfecto *et al*,2005),carbon sequestration (Jong *et al*,1997,Harmand and Hargoval,2007),Coffee shade trees also help farmers by income generations from the sale of their products (Beer,1987,Beer1988,vast *et al*,2006).

Coffee shade trees have positive impacts on coffee production system (Muschler,2001,Vast *et al*,2006,Avelino *et al*,2007). The yield of coffee was highly related with the number and size of the branches of coffee shade trees (Adugna Defaru *et al*,2011). Shade is more essential to coffee Arabica since the growth of coffee is negatively affected by high light intensity,high temperature and low soil moisture (Ashenafi Nigussie *et al*,2014). In coffee production systems,farmers select certain species of trees as coffee shade and remove other as which have adverse impacts on the growth and productivity of the coffee shrub. In Ethiopia coffee is generally grow under four types of production systems namely,forest,semi-forest,garden and plantation coffee.The major coffee production system in the high land of south western Ethiopia is reflected to as semi-forest coffee.Indigenous shade tree are very common features of the coffee production system in Ethiopia,although currently the existing valuable shade tree species are being depleted from the afro Afromontane rain forest by selective cutting for timber for example the depletion of *Cordia africana* (Jotie,2005). Various studies have listed the major important indigenous shade tree species in the coffee production systems of south west Ethiopia and the effect of these coffee shade trees on coffee plant productivity have been documented in Ethiopia (Kufa Taye,2007,Shimber *et al*,2002).

1.2 Research Questions

1 What are the most common shade trees in the study area?

2 What are the effects of shade trees on coffee productivity?

3 Besides to shade what are other importance of shade tree?

4 What looks like the current status of shade trees?

5 How did farmers manage trees in their coffee farm land in the study area?

6 What are the major threat factors of shade trees in the study area?

Hypothesis

The objective of this research were to identified the most common shade trees on coffee productivity,their distribution,phenology,management practices of farmers and major threat factors,so,I proposed the following hypothesis for shade trees under this study.

- Shade trees provide higher coffee productivity.
- Shade trees provide tree products and improve coffee quality.
- Intensive management of farmers in shad trees will suppress trees diversity.

2. OBJECTIVES

2.1 General Objective

The main objective of this study was to identify the major coffee shade tree species that are common in coffee farming systems,to assess their distribution and multipurpose values, management practices, major threats as well as their overall phenology.

2.2 Specific Objectives

- ✓ To identify and document coffee shade tree species in coffee farming systems
- ✓ Find out the socio economic and ecological benefit
- ✓ To examine the management practices of the local people
- ✓ To investigate the major threat of coffee shade tree species in the study area

3. LITERATURE REVIEW

3.1 Shade tree selection and management

Excessive shading or light interception by the upper two to three canopy strata various tree species is known to decrease growth and grain productivity of the crop (Kufa Taye and Burkhardth 2011,Soto-pinto *et al*,2000). A decrease in coffee production for shade cover above 50% from Chipas ,Mexico as a result there is along local tradition of managing coffee forests for coffee production by thinning the canopy through removing of some tree species (Schmitt et al ,2009,Gole Tadesse *et al*,2008). These coffee forests managers are typically small holder farmers who derive most of their income from coffee as it is the only cash crop for many of them (Gole Tadesse *et al*,2008).The traditional coffee tree management practice include thinning of the forest canopy by purposively retaining certain tree species in the semi forest and semi plantation coffee systems (Schmitt *et al*,2009,Aerts *et al*,2011,Hundera *et al*,2013). Tree selection is a complex phenomenon especially for diverse multi strata and low in put plantation (Soto-pinto *et al*,2007). Traditional tree species selection for coffee shade in Mexico was according to utilitarian and degree of environmental adaptation and crop compatibility another study in Mexico confirmed that the coffee shade tree species selection is based on farmers knowledge of the morphological physiological features of native tree species (Sonto-Pinto *et al*,2007). An assessment conducted in Costa Rica on preference of coffee shade trees showed that farmers decision on tree retention in their plantation was based on tree attributes such as height,crown width,leaf size,deciduousness and litter decomposition rate (Albertin and Nair,2004). Farmers also retain some trees on their coffee farmes for additional purposes likefruit trees,fire wood or honey production (Soto-pinto *et al*,2007,Muleta Driba *et al*,2011). According to (Muleta Driba *et al*,2011) in Ethiopia farmers retain shade trees in their coffee farms based on leaf and crown characteristics,tree height and their impact on coffee yield.

3.2 The Disadvantage of Coffee Shade Tree on Coffee Production System

The main negative effect of the use of trees in agro forestry system is competition with the associated crop (Beer et al,1998) according to (Ravet et al,1998) other potential dis advantage of using shade trees are reduced crop yields due to over shading and higher incidence of fungal

attacks by mycena citricolar due to increased humidity in the system and possibility of allelopatic effects between coffee and particular shade tree species (Beer,1987).

3.3 Shade trees phenology

Tropical trees exhibit substantial seasonality in flowering and fruiting events they often show temporal variation in phonological patterns that are associated with seasonality in climate or abundance or pressure of biotic factors (Sakai,2001). In forest with a marked dry season flowering and leaf flushing may be more sensitive to seasonal rain fall,changes in water availability may also enhance leaf flesh and fruit production.In strongly seasonal dry forests leaf flushing peaks during late dry season and ends in the rainy season (Anderson *et al*,2005,Justiniano and ,2000,Laren and Donald,2005).

3.4 Gedeo's indigenous agro forestry practice in southern Ethiopia

Gedeo traditional agro forestry composed of an assemblage of diverse,closely growing trees ,shrubs and annual crops that form a seemingly unbroken vegetation cover these agro practice is known to be an exemplary and use system in the region (Tadesse Kippie,2002,Sluf,2006),now a days,all members of the Gedeo community in the Zone area practice at least a home garden type of agro forestry were by subsistance crops are grown mixed with tress (Abiyot Legesse *et al* ,2013) agro forestry is defined as land use systems which integrate trees and shrubs on farm lands and rural land scapes to enhance productivity,profitability,diversity and eco system sustainability (Nair,1993). The Gedeo agro forestry practice comprises diverse species of annual and perennial crops which have ecological,social and economic benefits (Tadesse Kippie,2009).

3.4.1 Production potential of Gedeo's coffee agro forestry practice

Gedeo agro forestry advantages can be described as the provision of multiple products (food, fruit,vegetable,fodder,medicine,fuel wood and timber) which can generate income especially for small holders (Bishaw Badege,2003).

3.4.1.1 Honey production

Gedeo indigenous agro forestry are coved by forest tree,herbaceous flora of weeds cultivated crops and shrubs (Gebretsadik Teklu,2016). The trees,herbs and shrubs play a major role for honey production with tree species dominated by bearing bee flora yearly and therefore beekeeping should be integrated with the vegetation conservation for lively hood improvement and food security preferred pollen trees and shrubs in Gedeo indigenous agro forestry practice include coffee Arabica,Cordia africana,Croton macrostachys,Millettia ferruginea,Albizia schimperiana,Acacia abyssinica and Ficus vasta is the potential pollen tree in the area (Mesele Negash,2007,Gebretsadik Teklu,2016).

3.4.1.2 Food production

Enset ventricosum and coffee Arabica play central role in Gedeo agro forestry practice Enset ventricosum is one of the potential indigenous plant for food production in the area (Tadesse Kippie,2002,Brandt et al,1997). Fruit is another component of the Gedeo agro forestry system that are grown per dominantly in the lower altitude (Abiyot Legesse,2013,Mesele Negash,2007).

3.4.1.3 Fire Wood and Timber Production

Biomass based fuel accounts for 85% and 95% of the total energy and house hold consumption respectively (EARO,2000). Agro forestry can be contribute to energy substitution and becomes an important carbon off set option.production of fuel wood from the forests as a substitute for fossil fuel (Unruh et al,1993).

3.5 Ecological Potential of Gedeo's Indigenous Agro Forestry Practice

3.5.1 Carbon Sequestration

Global climate changes caused by rising levels of carbon dioxide (Co_2) and other greenhouse gases is recognized as a serious environmental issue of the twenty first century. Agro forestry systems are increasingly recognized for the provision of both climate change mitigation and adaptation service,the systems are often productive taking up large amount of Co_2 from the

atmosphere and storing the C in standing vegetation (biomass),soil organic matter and harvested biomass products (Losi *et al*,2003 and Montagnini and Nair,2004).

Carbon stocks of Gedeo indigenous agro forestry practice were found to be amongst the highest reported for tropical forests and agro forestry systems (Mesele Negash and Starr,2013) average simulated soil organic carbon stocks in Gedeo indigenous agro forestry systems were higher than those reported for other tropical agro forestry systems. The higher soil carbon stocks in the system can be attributed to the higher proportion trees and associated coarse litter and humus inputs,tree coffee systems,this was possibly due to the higher litter input from biomass compartment, more over tree coffee system is dominated by fruit trees with high litter fall inputs (Mesele Negash and Starr,2013).

Tree cohort substantially contributed to the simulated total biomass Carbon stocks while the share of Enset ventricosum and coffee were insignificant showing that trees play important role in carbon sequestration in the indigenous agro forestry systems (Mesele Negash *et al*,2015) this is due to following reasons

First most tree species in the over story of the Gedeo home garden are slow growing and long lived they can also form a large canopy volume with a high total carbon accumulation an example is Ficus vasta one of the most prominent canopy species which is slow growing tree that can attain a large size has a higher carbon density and can be credited with sequestering a maximum total carbon (Bishaw Badege *et al*,2013).

3.5.2 Soil and Water Conservation

Agro forestry system has the potential to improve soil fertility,reduce soil erosion and improve water availability (Jose,2009) furthermore the presence of deep rooted tress in the system can contribute to improved soil physical condition and higher soil micro biological activities under agro forestry (Nair et al,2008). More over the hydrology of the system is well maintained and enhanced by reduced evapo transpiration due to its canopy structure and pumping effect of tress (BogaleTefery,2007). Gedeo agro forestry practice has the ability of enhancing the yield of diverse crop or tree species by regularly replenish soil fertility and productivity through continuous supply of organic matter and through soil protection from erosion and leaching

(Tadesse Kippie,2002). The high litter fall production of the traditional Gedeo agro forestry systems take in to considerations for the high productivity of these systems (Mesele Negash,2013).

3.5.3 Importance of Bio diversity for Coffee Farmers

Coffee is grown areas that coincide with high bio diversity levels and where livelihoods depend on the forest and its services (De been houwer *et al*,2013). More complex shaded systems are known to provide habitants for different animal groups and therefore support a more diverse wild life community than systems managed with out shade (Bhagwat *et al*,2008),this greater bio diversity and more complex vegetation structure have been associated with different eco system services.The potential effect of natural pest control is particularly important as damage caused by pests and disease pose great risk for small scale coffee farmers empirical evidence from several studies suggests that for example birds can play an important role in minimizing the effect of pests (Perfecto *et al*,2004) found that more diverse shaded coffee systems supported a more diverse bird community,which increased predation,thus reducing plant and fruit damage.A bird exclusion study by (Kellerman *et al*,2008) showed that birds supplied ecologically and economically valuable services to Jamaican coffee farmers by reducing damage of the coffee berry borer.

4 MATERIALS AND METHOD

4.1 Descriptions of the study area

Kochere Woreda is altituding located between 1660-2532 masl,$5^0$55’30’’-$6^0$6’45’’latitudes to wards N and $38^0$6’0’’--$38^0$15’0’’ longitudes to wards E in the Gedeo Zone of the Southern Nations Nationalities and Peoples regional state of Ethiopia (fig1).Chelelektu town is the settlement of the Woreda administration which is located 420 km south east from Addis Ababa,150 km south of regional town Awassa and 67 km east of zonal town Dilla.The Woreda is sub divided in to 19 kebeles or peasant associations and one urban centers that is Fisehagenet.The Yirga Chefe,Chorso Woreda of Gedeo Zone at North and East respectively and the Oromiya National regional state at the South and West are borders to Kochere Woreda.

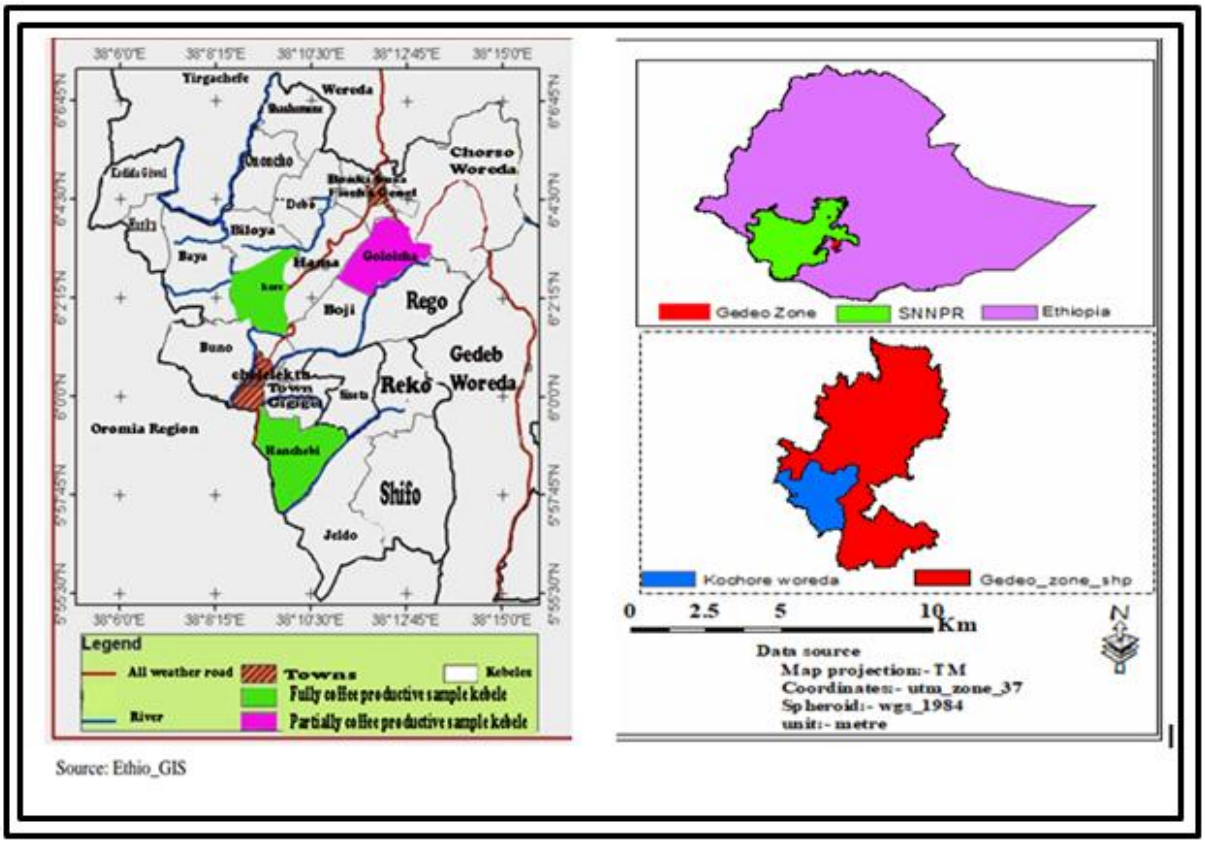
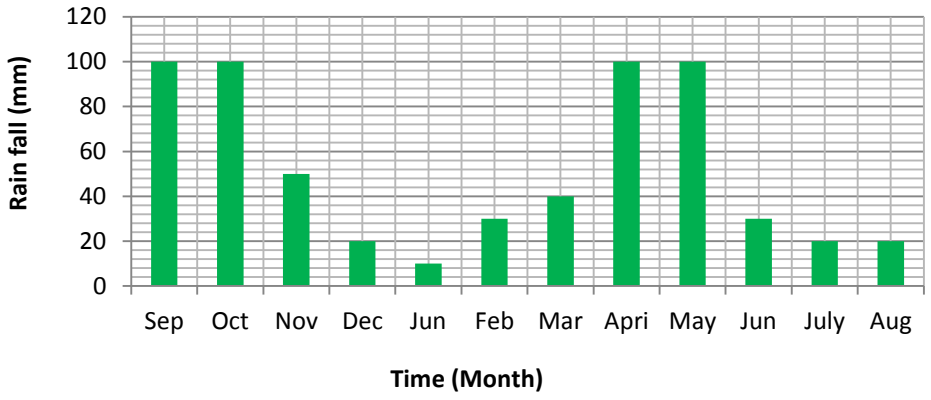


Figure1.Location and administrative map of Kochere Woreda of Gedeo Zone, SNNP regional state, Ethiopia.

The average annual temperature of the woreda ranges between12.5-25 degree centigrade and the average annual rain fall is measured from 900-1400mm.The Woreda has bimodal rain fall type that is the maximum amount is measured from april - may and september –october. The wettest months were found to be may and october,the driest months in turn are february, january and december. More over the coolest monthfound to be julywhereasmarch was found to be the hottest month.



Figer 2 Average rain fall of Kochere Woreda in mm

Source KWARDO.

The soil type of the Woreda is mostly red clay loam, red brownclay loam, and black grey loam (Tadesse Kippie,1994;KWARDO,2012).The major rivers and several lesser water shades are found in the Woreda that are potential and actual benefit provides for the local people. The major vegetation type of the Woreda is moist ever green Montana forest with well-developed agro forestry systems,perennial crop such as coffee and Enset ventricosum are the major components (Friis and Sebesebe Demissew,2001).

The total population of the Woreda is about 149321 and 3.7% of the population live in the urban centers and the majority of the population (96.3) living in the rural kebeles.The estimated population density of the Woreda is 457 people per square kilo meters(CSA,2005),the dominant ethnic group of the area being the Gedeo people and the Oromo peaple.The major language spoken in the Woreda is Gedeoffa followed by Amharic and oromo language ,the community livelihood is depend on rain fed agriculture .Coffee is the major cash crop and Enset ventricosum is the basic stable food cropsin addition annual crops and fruit are also important food source.

Overpopulation,over exploitation of components of home gardens and clearing land for intensive agriculture are major challenges of shade trees (KWARDO,2012). The Woreda is divided in to two agro climate type that is high lands (dega 2.5%) and low lands (woyna dega 97.5%).

From the total land coverage of the area 88% of the area were covered by perennial crops,4% by annual crops,2.5% covered by constructions and the remaining 5.5% covered by water bodies .browsing lands,forests,,bushes,wet lands ,uncualtivated and degraded lands(table1).

Table 1: The estimated land use type of the study area

No	Land cover	Hectare	%
1	Annual crop	851.21	4.2
2	Perennial	17877.11	88.85
3	Browsing	57.1	0.26
4	Natural forest	48.853	0.24
5	State forest	162.5	0.81
6	Community forest	2	0.01
7	Private forest	257	1.3
8	Land coved by bushes	36	0.18
9	Water bodies	35.4	0.18
10	Setlements	509.45	2.5
12	Wet lands	7.21	0.04
13	Un cultivated lands	47.32	0.24
14	Degraded lands	22.65	0.11
15	Others	209.74	1.01
16	Total land cover	20119.54	100

Source KWARDO.

4.2 Sample Size and Sampling Techniqu

Three peasant association were purposively selected one from the high lands (dega) that was partially coffee productive areas (Gololcha kebele) two from the the woyena dega kebeles(fully coffee productive kebeles,kore and Hanchebi) for sampling. 55 informants,24 from kore kebeles ,18 from Hanchebi,13 from Gololcha kebele were chosen by random sampling method these are 44 males and 11 females between the ages 18 to above 60 in which ten informants were purposively selected as a key informants which 7 males and 3 females the key informants were selected on the basis of knowledge of growing coffee and long experience of farming practices.

4.3 Data collection methods

Various methods were used for data collection.The methods used for data collection were Semi structured and structured interviews,questionnaires,group discussion and guided field observation.In the first phase of data collection checklists of questions were scheduled (Appendices I) and forwarded to the informants in a semi structured way. The interview focused on basic questions concerning the informant's knowledge on uses of shade trees,their distribution,management and threat factors. The direct field Observation was used to observe the distribution of coffee shade trees and management practices of the farmers. The structured and semi structured questions were forwarded to the key informants as interview and group discussion on the second round of data collection.

Following (Martin,1995) preference ranking was done to know the most important coffee shade trees,on the problems of coffee shade trees on coffee,problems of sun exposed growing coffee, shade tree distribution,management practices and threat factors and direct matrix ranking following (Cotton,1996) was done to know the socio economic importance of shade trees.

4.4 Methods for data analysis

Data collected through semi structured and structured interviews,group discussions,questioners and guided field observations. To analyse the collected data descriptive statistics such as appropriate percentage values,preference ranking following (Martin,1995) and direct matrix

ranking following (Cotton,1996) were used to analyse and summarize the data on the basis of coffee shade trees.

Following (Martin,1995) Preference ranking was done used to estimate the most important shade trees .List of shade trees that were most frequently mentioned and found important by almost all informants and presented to key informants so that they ordered them using their personal preferences. Species was selected for a particular rank based on frequencies of key informants the highest values they gave was 5 and the least value they gave 0. Shade trees with the highest sum of mentioned received the first rank and others took the rest successive ranks accordingly.

To evaluate the management practices of the farmers for coffee shade trees preference ranking (Martin1995) was done. List of management practices that were most mentioned by the informants and presented to key informants so they orderd them from their personal preferences .The highest value they gave 5 and the lwost valu 1. Management practice with the highest sum the first rank and others took the rest successive ranks accordingly.

Threat factors that mentiond by the informants also evaluate by preference ranking (Martin, 1995). Threat factors presented to key informants and they gave 5 for the most series threat factors and 1for the least. Threat factors with the highest sum the first rank and others took the rest successive ranks accordingly.

Following (Cotton,1996) direct matrix ranking was done through which an informant ranks a shade tree considering multiple criteria of comparison. Under the current study,six of coffee shade trees were ranked based on nine use criteria by the key informants. List of useful plants that are most frequently mentioned for the majority of informants as coffee shade and multipurpose vale plants were presented to the key informants so that they rank them using their personal preferences. The Informants were asked to assign the highest integer for use quality they consider the best,one for the least and zero not used for that criteria. The result from the ten key informants were added together to create a matrix that is representative to a community. Based on sum of the ranks by the ten key informants,plant species with the highest aggregated score took the first rank while others took the rest successive ranks accordingly.

5 RESULTS

5.1 Demographic Characterstics of the Informants

5.1.1 Sex and age of the Informants

For this study atotal of 55 informants selected from Kochere woreda.Thus 16(29%)of the respondents were between the age of 18-30,21(38%)were betwen31-40 years old,10(18%) were between 41-60 years old and 10(15%)of them were above 60 years old(Fig 3)

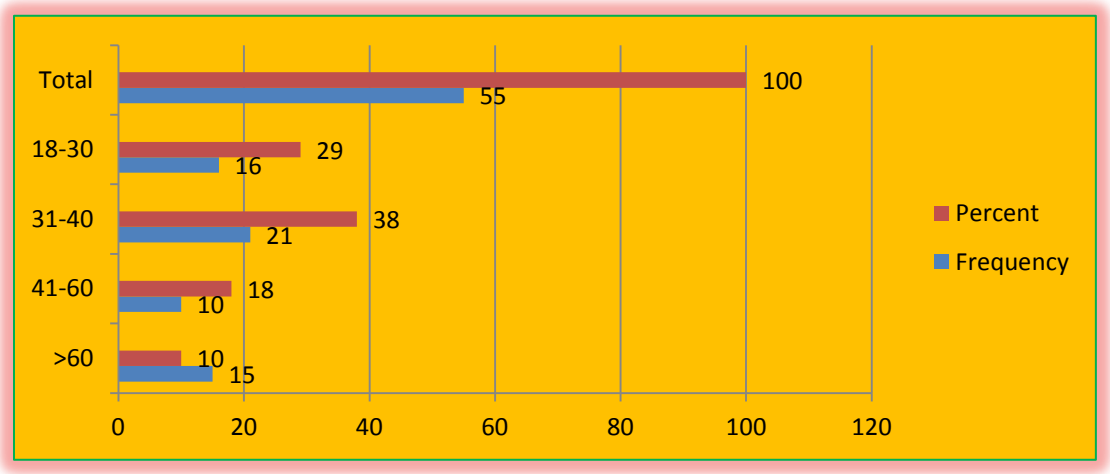


Fig 3 Age ranges of informants for the study(y-axis) and frequency of informants(x-axis) in Kchere Woreda Gedeo Zone.

5.1.2 Income Catagogry of the Informants

The informant's income category 34%(19) were only coffee income, 56%(31) have coffee, Enset ventricosum and fruit and the remaining 10%(5) have others.

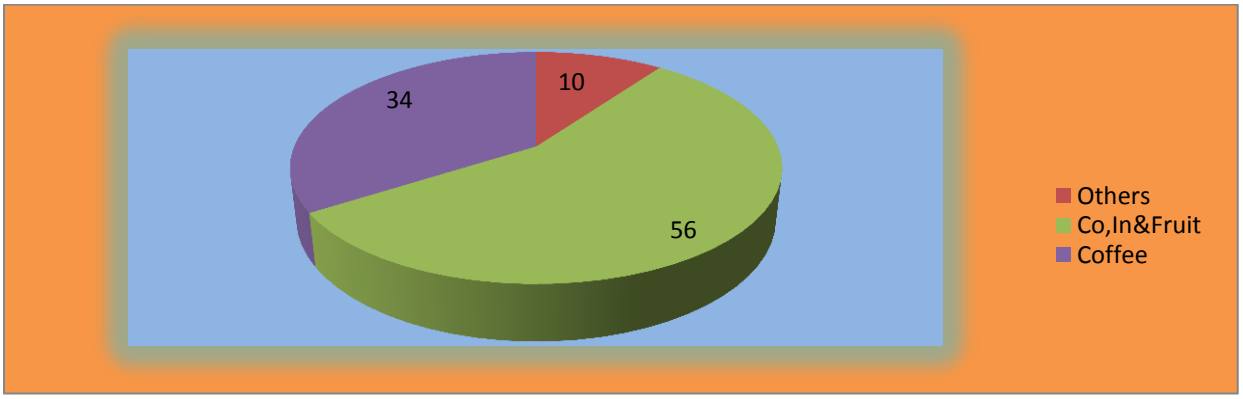


Fig 4 Income category of the informants in Kochere Woreda Geadeo Zone

5.1.3 Educational Level of the Informants

The informants educational levels:illiterate 14 %(8) ,those educated elementary 59%(32),secondary school 16% (9)and got higher education11 %(6) presented in(Fig 5).

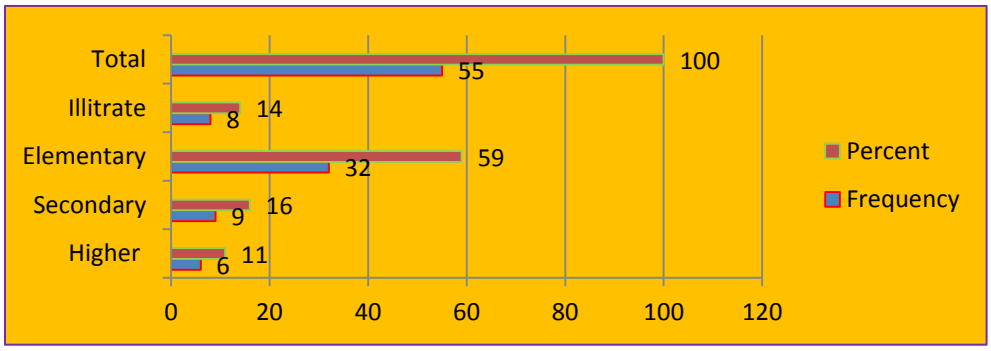


Fig 5 Educational levels of Informants in the(Y-axis) and frequency of the informants in (X-axis)in Kochere Woreda Geadeo Zone.

5.2 Farmer's Preference of Shade Trees

Farmers classified shade trees as suitable for coffee shade or unsuitable for coffee shade based on their height,growth rate,leaf size,canopy cover,crown type,root depth,deciduousness,life span and litter decomposition rate were among the characteristics that are taken into accounts when planting and protecting coffee shade tree.

Table (2) shows most of the respondents (71%) preferred deciduous shade tree compared to ever green ones (8%), most of the informants were preferred medium sized shade tree (76%) compared to large sized tree (20%).

Leaf size was also considered an important characteristics by the majority of the respondents which preferred trees with smaller leaves (72 %) to the large ones (0 %).Some farmers (80 %) preferred shade tree that has been depth root and some of the (20%) preferred shade trees that has been shallower root. All the respondents (100%) preferred shade tree that has fast liter decomposition rate and long life span. Other most important characteristics of shade trees preferred by farmers were canopy cover of the semi forest and crown type of the tree. Most of the farmers (78%) were preferred open canopy cover and wide crown type and some farmers (22%) preferred closed canopy cover and crown type of tree.

Table 2: Characteristics of shade tree preferred by farmers

Coffeeshadetree characteristics	Shade character state	No of respondents	Percent
Deciduousness	Deciduous	39	71
	Ever green	12	21.8
	No effect	4	7.3
Tree height	Large	11	20
	Small	2	3.6
	Medium	42	76.4
Leaf size	Small	40	72.72
	Big	0	0
	No effect	15	27.27
Canopy cover of semi forest and crown type of the tree	Open	43	78.18
	Closed	12	21.8
Root depth	Deeper	44	80
	Shallower	11	20
Liter decomposition rate	Fast	55	100
	Slow	0	0
Life span	Short	0	0
	Long	55	100

5.3 Criteria of Selection Permanent and Temporary Shade Trees

According to the respondents the criteria of selection of permanent and temporary shade tree ,temporary shade tree have fast growth rate than permanent shade tree and also temporary shade tree have short life span when compared to permanent shade tree. *Enset ventricosum ventricosum,Vernonia amygdalina* and *Sesbania sesban* are an example of temporary shade trees commonly used in the study area.

Table 3: Characteristics of permanent and temporary shade trees

1 characteristics of permanent shade tree					
Scientific name	Leaf size	Tree height	Liter decomposition	Deciduousness	Life span
Cordia africana	Large	Medium	Fast	Deciduous	Long
Croton macrosthys	Large	Medium	Fast	Deciduous	Long
Acacia abyssinica	Small	Medium	Fast	Deciduous	Long
Albizia schimperiana	Small	Medium	Fast	Deciduous	Long
Millettia ferruginea	Small	Medium	Fast	Deciduous	Long
Ficus vasta	Large	Tall	Fast	Deciduous	Long
2 Characteristics of temporary shade trees used in the study area					
Enset ventricosum ventricosem	Large	Medium	-	Ever green	Short
Vernonia amygdalina	Medium	Medium	Fast	Deciduous	Short
Sesbania sesban	Small	Medium	Fast	Deciduous	Short

5.4 Tree Species Commonly Used in Semi Forest Coffee Production System in the Study Area

A total of six commonly used coffee shade tree species were identified and documented by the researcher during field observation and by the responses of key informants in kochere Woreda semi forest coffee production systems which belongs to Fabaceae families (nitrogen fixing legume coffee shade tree) are the most dominant and highest diversity with species which include *Albizia schimperiana,Milletia ferruginea,*Acacia abyssinica and the other four families involved in the semi forest coffee production system of the study area were Boragenaceae,

Euphorbiaceae,Moraceae which include the species *Croton.macrosthyus*,*Cordia africana* and *Ficus vasta*

5.5 Coffee Shade Tree Comparisons

The highest value was assigned by key informants to Albizia schimperiana and *Millettia ferruginea* as the most preferred shade tree species in coffee plantation systems (table 4). Acacias and *Cordia africana* ranked 3rd and 4th respectively. Even though *Croton macrosthyus and Ficus vasta* was the least ranked shade tree species.

Table 4: Preference ranking of shade trees were used in the study area

5=the best,4=very good,3=good,2=less used,1=the least and 0=not used,k=key informants

Shade tree species	K_1-K_{10} coded Key informants											
	K_1	K_2	K_3	K_4	K_5	K_6	K_7	K_8	K_9	K_{10}	Total	Rank
Cordia Africana	2	3	2	2	4	3	2	3	4	2	27	4th
Crotin macrostachyus	0	2	0	0	1	3	2	3	4	4	19	5th
Millettia ferruginea	3	4	3	3	4	4	5	3	2	4	35	2nd
Albizia schimperiana	4	5	4	2	3	4	5	2	3	4	36	1st
Acacia abyssinica	5	3	3	2	4	3	4	3	2	3	32	3rd
Ficus vasta	1	0	1	0	1	2	3	2	2	2	14	6th

The respondents reported that the highest coffee yield performance were obtained under Albizia schimperiana and Millettia ferruginea than other coffee shade trees and the open sun(table4&fig 6). This coffee shade tree species attributed to the contributions of provide moderate light intensity through their small leaves and inrich soil fertility.

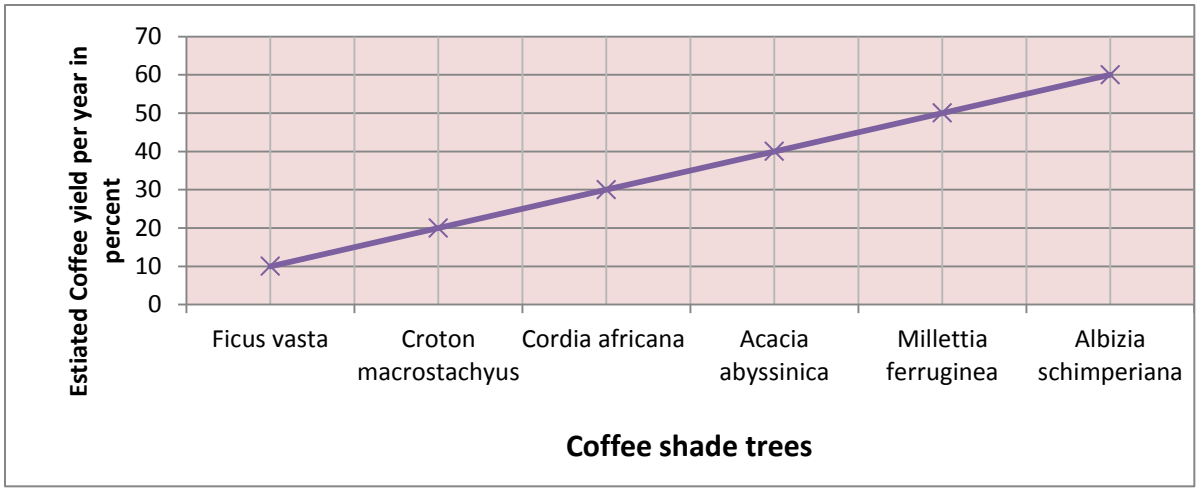


Fig 6 coffee productivity under the selected shade tree species

5.6 Identification of Coffee Shade Tree Based on Their Habit, position and origin

Most indigenous tree species can be used as coffee shade tree because they are less competition resource with coffee and other crops and they have highly ecological and socio economic importance for the local community. All shade trees which were selected are native and wild type (tab5).

Table 5: Identification of coffee shade trees based on their habit, position and origin

1 Identification of permanent shade tree based on their habit, position and origin				
Shade tree species	Family	Habit	Position	Origin
Albizia schimperiana	Fabaceae	Tree	Wild	Indigenous
Millettia ferruginea	Fabaceae	Tree	Wild	Indigenous
Acacia abyssinica	Fabaceae	Tree	Wild	Indigenous
Cordia africana	Boraginaceae	Tree	Wild	Indigenous
Crothon macrosthyus	Euphorbaceae	Tree	Wild	Indigenous
Ficus vasta	Moraceae	Tree	Wild	Indigenous
2 Identification of temporary shade tree based on their habit, status and nativity				
Sesbania sesban	Fabaceae	Tree	Wild	Indigenous
Vernonia amygdalina	Asteraceae	Tree	Wild	Indigenous
Enset ventricosum ventricosum	Moraceae	-	Domestic	Indigenous

5.7 Problems Related to Shade Trees in Coffee Production System

Concerning the undesirable influence of shade trees on coffee plantation the key informants highly emphasized on competition of resources (nutrient and water) and they gave the highest value. The other major effect of the shade trees on coffee productions system that the key informants strongly stressed the shade trees that create favorable environment for the occurrence of some coffee diseases e.g. *Croton macrosthyus*,big and large sized tress damage to coffee shrubs when they were falling Ficus vasta is an example that informants mentioned(table6).

Table 6: Preference ranking on the problems of shade trees on coffee shrubs

5= strongly agree, 4= agree, 3= disagree, 2= strongly disagree, 1= neutral,k=key informan

Problems in Trees in coffee plantation systems	K_1-k_{1O} coded key informants										Total	Rank
	K_1	K_2	K_3	K_4	K_5	K_6	K_7	K_8	K_9	K_{10}		
Competition for space	4	3	3	4	3	4	1	2	5	4	33	4th
Competitionfor resources (nutrients and water)	5	4	5	5	4	5	5	4	3	5	45	1st
Occurrence of disease & some insects and pests	5	5	4	3	5	3	5	4	4	5	43	2nd
Falling damage under story crop	5	5	5	4	3	2	3	5	2	1	35	3rd

5.8 Effects of Absence of Shade in Coffee Plantation System

Most of the participants of this study and the key informants highly stressed about the effect of absence of shade was increase yield reduction, decrease cup quality and decrease coffee bean size.Even though little emphasis on stunted growth and wilting of coffee plants

a b

Figure 7. Photos that shows Sun exposed and under shade growth coffee (photo by Nigatu in Hanchibi Kebele.Feb,2011).

Table 7: Preference ranking on the problems of sun exposed growing coffee

(5=strongly agree,4=agree,3=disagree,2=strongly disagree,1=neutral, k=key informants)

Problems of sun exposed growing coffee	K_1-K_{10} coded Key informants											
	K_1	K_2	K_3	K_4	K_5	K_6	K_7	K_8	K_9	K_{10}	Total	Rank
Prematurity of coffee beans	5	5	3	4	3	4	5	5	3	4	41	4th
Stunted growth of coffee	4	3	4	5	4	2	1	3	2	1	29	9th
Yield reduction	5	5	5	4	3	4	5	5	4	3	43	1st
Wilting of coffee plants	3	4	3	3	3	4	4	4	3	5	36	8th
Decrease bean size	5	5	5	5	4	3	5	3	4	4	43	1st
Decrease of cup quality	5	5	5	4	3	4	4	4	4	5	43	1st
Increase temperature and wind	4	4	5	4	5	5	4	4	3	2	40	5 th
Increase evapo transpiration	4	5	4	5	1	5	4	2	5	5	40	5th
Decrease soil fertility	5	5	5	4	3	4	3	3	4	4	40	5th

5.9 Current Status of Coffee Shade Trees and Their Diversity in the Study Area

From field observation and interview the most frequent and diversified coffee shade tree in the semi forest coffee production system of the study area were *Militia ferrginea,Albizia schimperiana and Croton machrosthyus* on the other hand *Cordia Africana* were scarcely diversified because of the local people over use this tree (table 8) and ficus vasta is also scarcely diversified due to undesiareble effect of coffee most of thefarmers not planting the tree in their farm land.

Table 8: Preference ranking coffee shade trees based on their degree of abundant

(5=most abundant,4 =fairly abundant,3 =least aboundant,2=few,1=not found, k=key informants).

Scientific name	K_1-K_{10} coded Key informants											
	K_1	K_2	K_3	K_4	K_5	K_6	K_7	K_8	K_9	K_{10}	Total	Rank
Millettia ferruginea	5	4	3	3	4	3	5	5	4	5	41	1st
Albizia schimperiana	5	5	2	3	3	4	3	4	5	4	39	2nd
Cordia Africana	5	3	3	2	4	3	3	5	2	2	31	5th
Croton macrosthyus	3	4	4	3	3	4	2	3	3	5	33	4th
Acacia abyssinica	4	3	5	4	2	3	4	5	5	4	38	3rd
Ficus vasta	1	2	2	1	2	2	1	2	4	3	21	6th

Cordia africana was the least abundant species in seedling and sampling,disturbance occurring in the area and immaturity of old trees to produce seed were considered as the cause of less regeneration of the tree. *Cordia africana* are the most locally useful indigenous plant species. Currently over harvesting of mature tree influenced the regeneration of the species. The inability of adult to establish large number of populations due to early harvest by local people was the cause of least abundant of sampling and seedling.

5.10 Phenology of the Selected Shad Trees

The studied deciduous plant species may shed their leaf annually.Both leaf flush and leaf fall were seasonal for example leaf fall of both *Cordia Africana* and *Croton macrosthyus* began in January /February and continued until march /April the period of leaf ness was may lasted three to four months. *Croton macrosthyus* leaf flushing commenced in march however *Cordia africana* were started in April.

In most species of the studied plants flowering lasted for three to four months the flowering periods coincided with the dry season for most species. However for Cordia Africana the flowering periods coincided with the rainy season. Duration of the flowering periods varied among the studied deciduous plant species.

most of the studied deciduous trees explicit one fruiting period per year. The duration of fruiting period vary from species to species,some species exhibited extended fruiting periods,in most species fruiting period was lasted towards the end of the dry season and /or the beginning of the rainy season.

5.11 Socio Economic and Ecological Value of Shade Trees

The selected key informants were asked to assign value to each coffee shade tree species for a particular service the highest value was assigned to *Cordia Africana* it is found to be highly used by local community for multipurpose.*Acacia abyssinica,Albizia schimperiana* and Millettia ferruginea were the second,the third and the fourth respectively. However Croton macrostachyus and Ficus vasta were the least.*Cordia Africana* ranked more for timber,medicine hive support, bee forage and making house hold material,*Albizia schimperiana,Mllettia ferruginea and Acacia abyssinica* were highly prefer for charcoal and fuel wood, bee forage and beehive support and Croton *macrostachyus* was highly preferred for traditional medicine,soil fertility,bee forage and beehive support,*Ficus vasta* for bee hive support and animal fodder(table 9).

Table 9:Direct matrix ranking so as to compare the use values of coffee shad tree species

(5=the best,4=very good,3=good,2=less used,1=the least,0=not used).

Coffee Shade tree	Use categories										
	Medicine	Soil fertility	Bee.food	Timber	Charcoal and firewood	Bee hive support	Animal fodder	Construction	Making house hold	Total	Rank
Millettia ferruginea	0	4	5	0	5	5	3	3	2	27	4th
Albizia schimperiana	5	5	5	0	5	5	0	5	5	35	3rd
Cordia Africana	5	5	5	5	3	5	4	5	5	42	1st
Croton macrosthyus	5	5	5	0	2	5	0	2	2	26	5th
Acacia abyssinica	0	5	5	3	5	5	5	4	4	36	2nd
Ficus vasta	0	5	1	0	5	5	5	0	4	25	6th
Total	15	29	26	8	25	30	17	19	22		
Rank	8th	2nd	3rd	9th	4th	1st	7th	6th	5th		

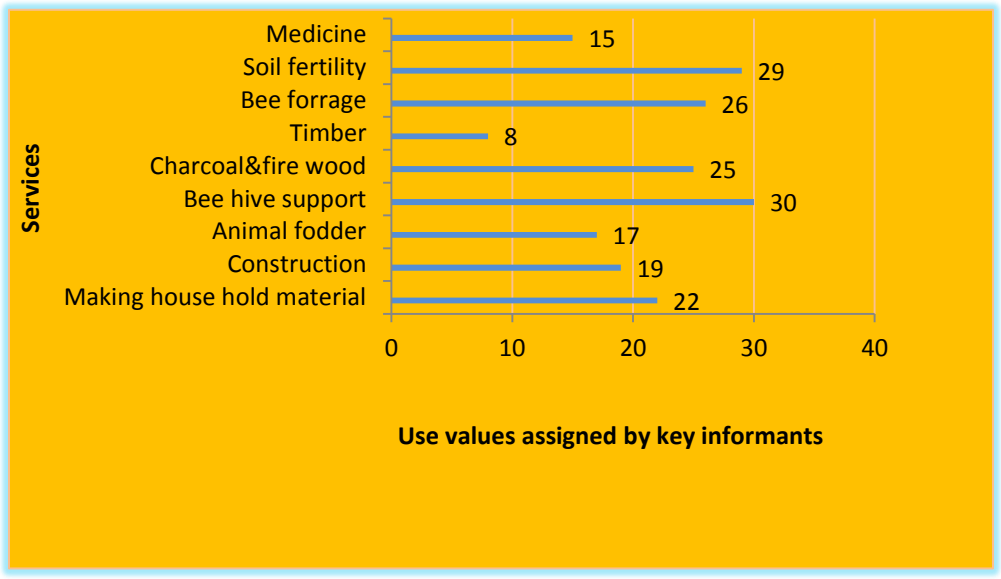


Fig 8:the service priorities of coffee shade trees.

Figure 9. Photos shows that coffee shade trees in honey production(Photo by Ahmed Agmas in kore kebele.**mar.2011).**

5.12 Management of Coffee Shade Trees

In the study area there are two nursery areas one was administered by Dilla university and one by the Woreda's agricultural and rural development office but this nursery areas mostly propagate coffee seedling,farmers used no special seed beds in their own farm areas to propagate coffee shade tree so seedlings of *Millettia ferrugenia,Albizia schimperiana,Cordia Africana,*Acacia abyssinica,*Croton macrosthyus* and *Ficus vasta* regenerate naturally in the wild. The roles of farmers were marked and protect the desirable seedlings in the coffee farm. Removing of weeds,inter cropping,protecting natural regeneration plants,looping as well as pollarding and debarking were constitute the major management practice (table 10). Most of the interviewed informants responded that weeding occurs one or two times in a year so farmers remove these weeds to avoid competition for both nutrients and water. Dead weeds can be used as mulching and mulching can reduce the amount of weeds in the coffee farm. Weed remove practice will provide sustaining volume of organic matter which will improve the soil fertility.

Table 10: Responses of the key informants to the priority preference ranking on shade tree management practice in the study area .

(5=strongly agree,4=agree,3 =disagree,2=strongly disagree,1=neutral,k=key informants).

Management type	K_1-K_{10} coded key informants											
	K_1	K_2	K_3	K_4	K_5	K_6	K_7	K_8	K_9	K_{10}	Total	Rank
Debarking	3	2	4	3	2	1	2	1	5	5	28	7th
Removing weed	5	5	4	4	5	5	4	4	5	5	46	1st
Lopping	3	4	5	2	4	4	4	3	5	5	39	5th
Intercropping	5	3	2	4	5	3	5	5	4	3	41	3rd
Pollarding side branches	4	4	3	4	5	4	4	5	3	4	40	4th
Planting	2	3	4	3	2	3	3	4	3	5	32	6th
Protecting natural regeneration plant	5	5	5	4	5	4	5	3	4	4	44	2nd

According to informants pollarding (cutting side branches),lopping(cutting the shoots) and debarking(reducing shade trees in the coffee farm) was done to reduce excessive shading of plants and provide sufficient circulation of air ,sun light for the flowering and fruiting and enables to reach the rain to the root of the coffee shrubs.It helps to achive the desired plant shape and contribute to sustainable higher yields.

In the correlation analyses canopy closure has shown positive correlation with tree density and average tree height and moderate shade conditions is favorable for good coffee growth and high coffee yield. Howeve excessive shading is negatively correlated to coffee productivity and quality

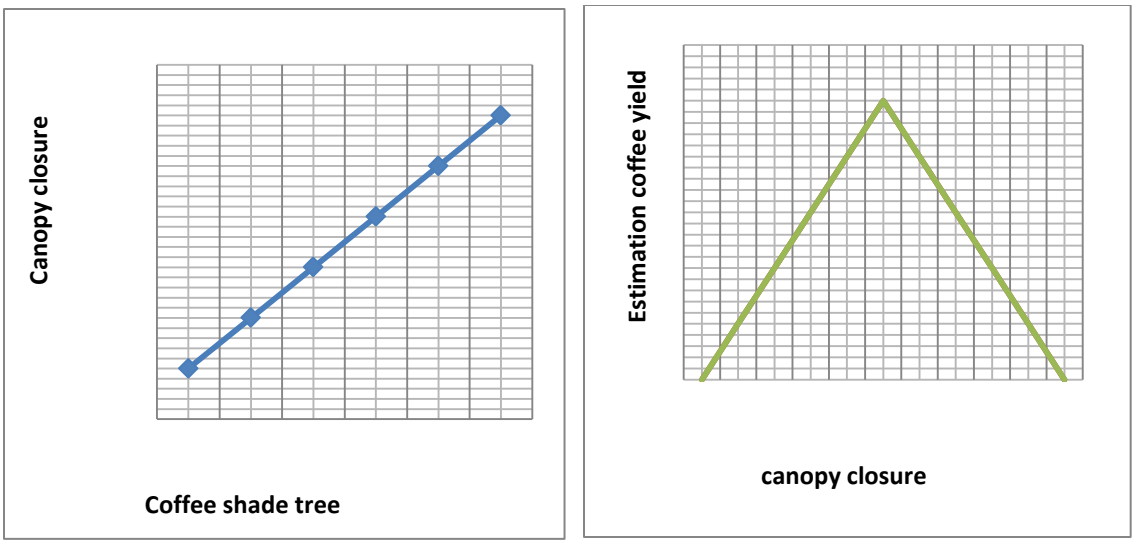


Fig 10 a relation ship of shade tees and canopy closures b)impacy of canopy closure on coffee yield.

5.13 Threats of Coffee Shade Trees

People started exploited the natural environment as the source of their lively hoods such as medicine,shade,fire wood,timber productions. On the other hand unsustainable utilization of plants promote negative effects,peoples, in the study area have traditionally depended on plant resources,in the study area highly diversified plant species was found which are ecologically and economically important. Regarding to threats of coffee shade tree informants clearly put their worries about the future prospects of these shade trees under the existing dynamics. There are some signals regarding the pressure that are threating the trees and the lively hood of the local people. This study identified population growth was a potential threat to sustainability of the coffee shade trees the rising population density consequently brought unsustainable utilization and over harvesting of indigenous tree as a source of fire wood and charcoal,medicine,house materials,constructions and source of income by selling for timber and use wide range of areas for settlement,consequently the cutting rate of indigenous trees has risen at a much higher rate than their replacement.

Figure 11: Photos shows that Charcoal and timber market in Chelelektu Town(photos by Ahmed Agmas Feb.2011).

Table 11:priority preference ranking of threat factors to coffee shade trees

5=strongly agree,4=agree,3 =disagree,2=strongly disagree,1=neutral,k=key informants

Major factors	K_1-K_{10} coded for key informants											
	K_1	k_2	K_3	K_4	K_5	K_6	K_7	k_8	K_9	K_{10}	Total	Rank
population growth	5	5	5	4	4	3	5	5	4	5	45	1st
Illegal logging or selective cutting	5	4	4	5	2	2	4	4	3	5	38	3rd
Over harvesting	5	4	3	2	4	5	3	2	5	4	39	2nd
Timber	4	4	3	3	3	5	4	3	4	5	38	3rd
Charcoal and fire wood	4	5	5	3	5	5	2	4	2	3	38	3rd
Increase urbanization	1	3	2	2	2	3	3	2	5	5	28	6th
Construction	2	2	5	4	3	3	2	3	1	4	29	5th
Farming	3	3	1	1	3	3	4	4	3	1	26	7th
Browsing	1	1	2	2	4	2	3	2	1	1	19	9th

The lowest ranked major threat factors that identified by farmers was farming and browsing (table11). The Woreda agricultural and forest development office formulate different strategies to stop the destruction of indigenous trees.Strategies were used by the woreda agricultural and rural development office were,identified the most valuable and scared tree species and give identification numbers for each individual tree and punish the farmers that were cut down the trees without the permission of the Woreda Agricultural office.

Figure 12: the agricultural and forest development office give tag and cod number for the selected plant species cutting illegally(photo by Ahmed Agmas in Hanchibi kebele jun.2011).

I observed that during the time of field observation the agricultural and forest development office of the Kochere Woreda works cooperate with the Woreda police,kebele administration and rural development extension workers to stop illegal cutting of shade trees.

6. DISCUSSIONS

6.1 Farmers Preference of Coffee Shade Trees

Farmers can be very knowledgeable on coffee shade trees from experience they are aware of interactions between shade tree species and coffee. So,farmers knowledge might provide novel insight in to increase productivity.

Coffee producer farmers categorized coffee shade trees as suitable for coffee farming or undesirable based on their height, liter decomposition rate,leaf size,and root system attribute similarly (Schmitt *et al*,2009) indicated that there is along local tradition of managing coffee forests for coffee production by thinning the canopy through removal of some tree species. Most of the respondent's preferred deciduous shade tree compared to ever green similar results in (Canell,1974) coffee shrubs needs to be shade in its all developmental stage especially during dry and sunny seasons. Most farmers preferred trees that have intermediate height and that have fast growth rate because of the farmers select this type of shade trees were provision of good shade to coffee, intermediate height shade trees better than to large trees. The effect of large sized coffee shade trees were damage coffee shrubs when falling, fast litter decomposition rate were favored by all the informants.The major reason farmers selected plants that have fast litter decomposition rate was when plants decomposed plant residues are returned to the soil and various organic compounds undergo deposited in to the soil (Swift *et al*,1979). Climate,soil and microorganisms as being most important factors in leaf decomposition.

Root depth is another important criterion of selecting trees as a shade. Farmers preferred root depth trees because they absorb minerals nutrients and water depth from the soil and they are less competitive. Farmers argue strongly root contributes to maintain and regulate soil fertility similarly (Scroth,1995) noted that reducing below ground competition may be achieved by selecting tress with less competitive root architecture ,i.e deep rooted tress with few roots in the upper soil layers are preferred by farmers. The majority of the informants preferred open canopy cover and wide crown type of shade trees because the coffee shrub need moderate shade condition to produce good cup quality and which is also important for coffee growth. However soil is more protected in a dense canopy than an open canopy during high intensity of flooding.

6.2 Permanent and Temporally Coffee Shade Trees

In hot environment temporarily shade trees are needed to protect the young coffee shrubs from the high temperature until permanent shade tree have fully grown to provide appropriate shading, some of the temporarily shade trees used in the study area include *Enset ventricosum ventricosum,Vernonia amygdalina* and *Sensbania sesban*. Common permanent shade trees used in coffee plantation system include Albizia schimperiana,*Millettia ferruginea,Cordia africana ,Croton macrostachus,*Acacia abyssinica and *Ficus vasta.* Temporary shade trees have faster growth rate and short life span than permanent shade trees.

6.3 Comparison of Coffee Shade Trees

Millettia ferruginea and Albizia schimperiana were the most important shade tree species in coffee plantation systems. Several studies also reported the importance of Albizia *schimperiana* for coffee production in Ethiopia as a leguminous plant can form a symbiotic relationship with rhizobia bacteria to fix atmospheric nitrogen resulted in increased soil fertility (DeBeen Ovwer *et al*,2016). Other studies also show that with an open wide spreading crown provides good shade cover for coffee production leading to improved micro climate and coffee yield (Hemp,2006,KufaTaye *et al*,2007). Another advantage of *Albizia.schimperiana* is that its leaves emerge in the dry season (Belay Beyene *et al*,2019) this means it can provide shade when there is a lot of sun and prevents coffee from being to densely shade during the rainy season next to *Albizia.schimperiana* tree species favored by farmers was *Millettia ferruginea,*the other shade tree species associated with improvements of condition for coffee production are also *Cordia africana* ,Acacia abyssinica,*Croton macrosthyus and Ficus vasta* ranked as an important shade tree species. Even though (Kufa Taye *et al*,2007) found high coffee yield under *Cordia africana.*

Cordia africana is also reported as an essential shade tree in coffee production in Kenya (Lamond *et al,*2016),Uganda (Gram *et al*,2018). They also reported the highest yield variation under this tree species.*Cordia africana* is a highly quality timber tree, the economic value might be a major reasoned for farmers to grow it.

6.4 Problems Related to Shade Trees in Coffee Production (plantation systems).

The major negative effect of the shade trees that, interviewed informants explained that resources (nutrient and water) competition with coffee shrubs,formation of suitable environment for the incidence of some coffee disease and damage to coffee shrub's when falling the tree similarly (Beer *et al*,1998) showed that the main negative impact of the use of shade trees in agro forestry systems is competition with the associated crop.

6.5 Effects of Absence of Shade in Coffee Plantation System

The interviewed informants reported that when coffee shrubs exposed to sun light can cause yield reduction,decrease cup quality and decrease bean size and pre maturity of coffee beans similar results (DaMatta,2004) showed that exposing coffee plants continuously to extreme temperature can cause a reduction in coffee yield due to depressed growth and occurrence of abnormalities of coffee shrubs such as yellowing of leaves. Similarly (Muschler,2001) indicated that shade may positively affect bean size and as well as beverage quality, poor beverage quality is obtained if coffee bean have not reached its full development.

6.6 Multipurpose Values of Shade Trees

Cordia africana was found to be highly used by local community for multipurpose.*Cordia africana* ranked more for timber, bee hive support, bee forage and making house hold materials similarly (Legess Negash,2010) indicated that *Cordia africana* is one of Ethiopia's most important tree species such tree have an excellent honey tree, producing bee hives ,medicinal values,excellent source of timber and the tree have a significant role in nutrients pumping and hence it is important for agricultural productivity according to (Legesse Negash,2010) *Cordia africana* is particularly suitable not only for soil formation and conservation but also water retention and flood control.

Albizia schimperiana,Millettia ferruginea and acacias were highly preferred for charcoal and fire wood, bee forage and beehives support similarly (Legesse Negash,2010) indicates *Albizia schimperiana,Millettia ferruginea* and Acacia abyssinica were used as good source of fire wood

and charcoal,*Croton macrosthyus* was preferred highly for soil fertility regulation and water conservation according to the informants and (Legesse Negash,2010) indicated that both *Croton macrosthyus and Albizia.schimperiana* were unpalatable to both domestic and wild animals. According to (Legesse Negash,2010) Acacia abyssinica were the most significant trees to conserve bio diversity because the tree was used as food and habitats for wild animals,birds and insects and the tree extract water and minerals deep from the soil and it improves soil fertility.

6.7 Management of Coffee Shade Trees

In order to improve productivity and quality of coffee farmers used different strategies thus farmers regularly removes weeds and under story shrubs two times or three times per year. Weed should be controlled as they compete mineral nutrients with coffee shrubs and other associated crops.Dead and dry weeds can be used as mulch and the fallen leaves from the shade trees acting as natural mulch so as, mulching involves covering the soil with the layer of dry vegetation and this reduce the amount of weed and increase the soil nutrient levels.

In the study area farmers were not regularly and frequently planted trees but they tend to manage and protect what is already there and what grows from natural regeneration .In the study area the majority of shade trees established by natural regeneration. The growth of shade trees controlled by pollarding the side branches to avoid excessive shade similarly (Silva *et al*,1990) indicated that the proper selection and management of permanent shade tree species can reduce labor input and weeding costs.

Shade tree management by farmers include weeding shrubs, pollarding,lopping and debarking, lopping and pollarding is an essential shade tree management of coffee production and it involves thinning of branches and it prevents the tree growing too be tall and it enhance to make the desired shape in coffee production this enables opening the canopy this makes the light reaches the coffee shrubs and it can be optimize and air circulates freely in the soil. The other major and important aspect of management practice was intercropping (agro forestry practice). The Gedeo people is well known in agro forestry practice (inter cropping) farmers in the study area used intercrops like perennial crops,annual crops and fruit trees it provide as a shade in coffee plantation in addition to shade provision it provides food and generates of income to the local people. In addition to economic importance intercropping has so many ecological benefits

such as a complementary sharing of plant resources such as nitrogen from N fixing plants, weed suppression and a reduction in susceptibility to insect pests and disease.

6.8 Threats of Coffee Shade Trees

According to key informants fast population growth was the most threat factors of shade trees. The rising population consequently brought over harvesting of indigenous tree as a source of fire wood and charcoal,timber,medicine,house hold material,construction and source of income by selling the tree similarly (Tesfaye Abrha,2007) indicated particularly some of the current contributory factors accelerating the decline of wood species diversity in Ethiopia are the size and the distribution of human and domestic animal population,the level of resource consumption, market factors and policies. Along the fast population growth there is a high demand for fire wood and timber production it is also used for construction,house hold material,animal fodder, bee forage and provides other environmental and social services to the community (Markos Kumma *et al*, 2015).

7. CONCLUSIONS AND RECOMMENDATION

7.1 Conclusions

The livelihoods of Geadeo's people highly dependent on coffee,Enset ventricosum,fruit and coffee shade trees but the pressure of increasing human population leads the high demands of needs and over harvesting of shade tree are the major threating factors of shade trees as well as threats for sustainable production of coffee.

The study area well known by agroforestry systems it have a high potential for increasing bio diversity by providing habitat for a host of birds,reptiles,insects and wild animals. Therefore conservation of shade trees as a means of conserving bio diversity because the selected representative shade tree species have a huge impact on biodiversity and consequently on ecosystem services generated from the forest.

Farmers have an excellent knowledge on uses, protection and management practice of coffee shade trees.However some of the informants were deficient on some basic concepts of coffee shade agro forest systems. Therefore training on uses of different coffee shade trees management practice and other overall interactions of coffee with shade tree should provide to farmers to improve their local knowledge.

In the study area the most common coffee shade tree species were selected thus,*Millettia ferruginea(Hochst.) Hochst.ex Baker,Albizia schimperiana Oliv,Cordia africana Lam,*Acacia abyssinica Hochst.ex,*Croton macrosthyus Hochst.ex* Del and *Ficus vasta Frossk.* The highest yield of coffee were obtained under *Albizia schimperiana Oliv* and *Millettia ferruginea(Hochst.) Hochst.*ex Baker. *Cordia africana* were the most valuable shade trees in the study area. Shade grown coffee plants produce large and heavier bean sizes and better cup quality than coffee plants grow under full sun. Tree cover is used to moderate temperature,humidity and sunlight.

7.2 Recommendations

Farmers should be determined appropriate shade trees to maximize coffee productivity and select shade trees that have best suited for coffee production like *Albizia schimperiana* Oliv and *Millettia ferruginea(Hochst.) Hochst.ex Baker.*

Farmers should be avoid inter cropping crops that have adverse effects on coffee productivity like maize and Eucalyptus. To enhance sustainability of shade trees and to get sustainable quality of coffee production avoid over harvesting of shade trees. Therefore farmers use effective conservation,management practices and sustainable use of the forests with coffee shrubs so,the involvement of many stakeholders should be needed.

The most important thing is family planning because in the study area human population is dramatically increase time to time and it is a driving force for plant populations to decline and have a negative effect on bio diversity therefore different stake holders highly participate to create an awareness about family planning specialy the Woreda health centers.

REFERENCES

Albertin.A and Nair PKR (2004). Farmers Perspectives on the Role of Shade Trees in Coffee Productiion Systems:An Assessment from the Nicoya Peninsula ,Costa Rica. Human Ecology32,443 -463.

Abiyot Legesse (2013). The Dynamic of Indigenous Knowledge performing to Agro forest Gedeo; Implications for Sustainability .Ph.D dissertation: University of South Africa.

Abiyot Legesse,Bogale Teferi and Axel Baudovin (2013). Indigenous Agroforestry knowledge Transmission and young people's Participations in Agroforestry Practices the case of Wonago,Gedeo,Southern Ethiopia. The reporters series A.NO.26.

Aerts,R.Hundera,K.Berecha,G.Gibelss, P.Bacten M.Van Mechelen M.Hermy M.Muys B. Honnay.O (2011). Semi forest Coffee Cultivation and the Conservation of Ethiopia Afro montane rain forest fragments: Forest Ecology and Management. 261, 1031-1041.

Adugna Defaru,Bote.A.D and Paule,struik (2011). Effects of Shade on growth, production and quality of coffee(*Coffee arabica*): In Ethiopia Journal of Horticulture and Forestry.3(11),pp,336-341.

Anderson.D,V.E Nordheim,C.T Moermond ,B.Z Gonebi and C.Boesch (2005). Factors Influencing tree Phenology.InTai National park, Cotedivoire.Biotropica 3,631 -641.

Ashenafi Nigussie,Endale Taye and Guta Bukero (2014). Survey on Potential and Constraints of Shade tree Species for Arabica Coffee Production: In South Ethiopia. International Journal of Recent research in life Science 1,1-11.

Avelino.J,Barbora .B,Davrieux .Fand Guyot (2007). Shade effects on Sensory and Chemic Characteristics of Coffee from very high altitude Plantation in Coffee: In Second international symposium on multi –Strata Agroforestry systems with perennial crops making ecosystems services count farmers, consumers and the environment. September 17 Turrialba ,Costa Rica.

Beer.J (1987). Advantages, disadvantages and desirable characteristics of shade trees for coffee, cacao and tea: Agroforestry system 3-13.

Beer,J,Mushler,R,Kass,D andSomarriba.E (1998). Shade management in coffee and cacao plantation:Agro forestry systems 38,139-164.

Belay Beyene ,Zewdie Solomon ,Mekuria Wolde,Abiyu Abrham ,Amare Dagninet,Woldemariam Tadesse(2019). Woody species diversity and Coffee Production in remnant semi natural dry afro montana Forest: In zegie peninsula, Ethiopia .Agro forest 93 ,1793-1806.

Bhagwat S.A,willis.K.J,Birks.H.J.B.Whittaker R.J (2008). Agroforestry: Arefuge Tropical bio diversity Trends. Ecol Evol.23.

Bishaw Badege,Henry Neufeldt,Jeremias Mowo,Abdu Abdel Kadir,Jonathan Muriuki,Gemedo Dalle,Tewodros Assefa ,Kathleen Guillozet ,Habtemariam kassa,Ian K.Daws,Bishula Nazh Regm (2003). Contribution of Agroforestry for rural lively hoods: a case of Dhading districts,Nepal.

BogaleTeferi (2007). Agroforestry practice in Gedeo Zone,Ethiopia:A Geographical Analysis .PhD,Dissertation.188 .punjab university, India.

Brandt S.A,Spring.A,Hiebsch.C,Mc Cabe J.T,Endale Tabogie,Mulugeta Diro.M,wolde – Michael.G,Yantiso G, Shiegeta .M ,Tesfaye.S (1997). The Tree Against Enset ventricosum based Agricultural systems in Ethiopia:America Association for the Advancement of sciences with Awassa Agricultural Research center.Kyota University Center .African Area studies and University of flora,Washington DC.

Canell.M.G (1974). Factors affecting coffee Arabica bean size in kenya:Journal of horticulture science 4,65-76.

Cotton.C.M (19960). Ethnobotany:Principles and applications.JohnWiley and Sons Ltd.Chichaister,England.

Martin,G.J (1995). Ethnobotany:A method manual.Chapman and and Hall,London,268pp.

CSA (2005). National Statistics,Central Statistical Agency:Addis Ababa,Ethiopia.

Damatta F.M (2004). Eco physiological constraints on the production of shade and un shaded Coffee field crops research 86, 99-114.

De Been Houwer.M,Geerae.L,Mertens.J,VanGeel.M,Aerts .R,Vander haegen .K ,Honnay.R (2016). Bio diversity and carbon storage carbon benefits of coffee agroforestry: Agradient of Increasing Management Intensity in the SW Ethiopia high lands. Agric Ecosystem Enwer,Aerts,R.Honna (2013).A global Meta-analysis of the Bio diversity and eco systems service benefits of coffee and cacao agro forestry: Agric .Ecosystem .Environ 175 ,1-7.

EARO (Ethiopia Agricultural Research Organization,2000). Forestry research strategies for forestery research.EARO,Addis Abeba.

Friis.I and Sebesebe Demissew (2001).Vegetation map of Ethiopia are view of existing maps and the need for a new map for the flora of Ethiopia and Eritrea. Kongeliga.

Gole Tadese Woldemariam ,W.T Borsch,M.Dench and Teketay Desta (2008). Floristic Composition and Environment Factors Characteristics Coffee forests in South Ethiopia: Forest Ecology and Management 255, 2138 -2150.

Gram.G,vastVander Wolf,J.Jassogne (2018). Local tree knowledge can fast track agro forest Recommendation for coffee small holders along aclimate gradient: In Mountain Elgon, Uganda.Agro fo restry system 92, 1625-1638.

Harmands J.M and Hergoval C.H (2007). Carbon sequestration in Ariel biomass and derived Products from coffee agroforestry systems in Central America.In:Second International symposium on Multi-strata agroforestry Systems with perennial crops. Making ecosystem services count for Farmers,Consumers and Environment Turrialba,CostaRca September, 17-21.Turrialba.

Hemp.A (2006). The banana forests of Kilimanjaro Bio diversity and Conservation of the chaga Garden Bio diverse conserve 15,1993-1217.

Hundra.k,Aerts.R,Fontaine.A,Vane Mechalen.M,Gijbels.P,Honnay.O,Muys.B (2013). Effects of Coffee Management Intensity on Composition ,Structure and Regeneration Status of Ethiopian Moist ever green Afro montaine Forests.Environmental Management 51:801-809.

Jong B.H,Soto-pinto M.L,Montoya,Gomez.G,Nelson.K,Taylor.J,Tipper.R (1997). Forestry and agroforestry land-use systems for carbon mitigation:An analysis in Chiapas, Mexico.In Climate change Mitigation and European use policies.CAB international ppp,246-269.

Jose.S (2009). Agroforestry for ecosystems services and environmental benefits:an overview Agro forest Systems,1-10.

Jotie. Z (2005). The influence of indigenous institution in the conservation and use of coffee Arabica the case of Yayo Forests in IluAbba Bora zone South west Ethiopia MSc thesis from Addis Ababa University,School of graduate Studies:Department of Sociology and Socio Anthropology.Addis Ababa,Ethiopia.

Justiniano.M and T.Frederickson(2000). Phenology of tree species in Bolivian dry forests. Biotropica 32,276-280.

Keller man J.L,Johnson M.D,Stercho A.M,Hackett S.C (2008). Ecological and Economic Services provided by Birds on Jamaican Blue Mountain coffee Farms. Conserve.Biol.22,1177-1155.

Kimemia, J.k (2007). Influence of an Albizia shade tree on soil chemical properties: Coffee plant Growth and yield in Kenya,Montpelier,France.pp.1199-1202 .

Kufa Taye,Yilma A,Shimber.T,Nestere Anteneh andTaye E (2007).Yield performance of coffee Arabica cultivates under different shade tree at jimma research Center, South west Ethiopia: In Second International symposium on multi strata agroforestry system with Perennial Crops:Making ecosystem services count for Farmers ,Consumers and the environment,September 17-21,Turrialba Costa Rica.

Kufa Taye and Burk hardt M .J (2011). Plant composition and growth of wild Coffee arabica Implementation for Management and Conservation of Natural forests:Resource International Journal of Biodiversity and conservation 3,131-141.

KWARDO:-Kochere WoredaAgriculture and rural Divelopment Office (2012). Annual report, unPublished.Chelelektu.

Lamond.G,San Brook.L,Gassner.A,Sinclair.F.I (2016). Local knowledge of Tree attributes under ten species selections on coffee farms,1-15.

Legesse Negash (2010). A selection of Ethiopians Indigenous Tree Biology, uses and propagationTechnique's :Addis Ababa University press, Addis Ababa, Ethiopia .

Lin,B.B (2007). Agroforestry Management as an Adaptive Strategy Against Potential Micro Climate Extrems in Coffee agriculture.Agricultural and Forest Meterology,144(1-2):85-94.

Losi J.C,Siccama G.T,Condit.R and Moralls.E.J (2003). Analysis of alternative methods for Estimating carbon stocks in young tropical Plantations for Ecology Management 184,355-368.

Markos kumma,Simon Shibru (2015). Floristic Composition,Vegetation structure and regeneration status of woody plant species of oda forests of Humbo Carbon project. Wolaita, Ethiopia, Journal of botany1,1-9.

Martin,G.J (1995). Ethnobotany:Amethod manual.Chapman and Hall,London,268pp.

MC Laren.K and.Mc.Donald (2005). Seasonal pattern of flowering and fruiting of a dry Tropical forest in Jamaica.Biotropica 37,584 -590.

Mesele Negash (2007). Tress management and livelihoods in Gedeos Agro forests Ethiopia: Forests Trees and livelihoods 17(2),157-168.

Messele Negash,Starr.M (2013). Litter -fall production and associated carbon and nitrogen fluxes of Seven woody species grow in indigenous agroforestry systems:In the rift Valley escarpment of Ethiopia .Nutrition Cyclic Agroforestry 971, 24-41.

Messele Negash (2013). The indigenous agroforestry systems of the south eastern rift valley Escarpment Ethiopia: Their biodiversity, carbon stocks, and litter fall.Tropical Forestry Reports No.44.Doctoral Thesis .University of Helsinki.

Messele Negash and Starr Mike (2015). Biomass an soil Carbon Stocks of indigenous agroforestry Systems on the South-Eastern Rift valley Escarpment Ethiopia Springed : International Publishing,Switzerland.

Montagnini.Fand Nair P.K.R (2004). Carbon sequestration:An under exploited Environmental Benefits of Agroforestry systems 611,281-295.

Muleta Driba,Assefa Fikadu,Nemomissa,S and Granhall.U (2008). Distribution of arbsucular mycorrhizal Fungi spores in soils of small holder agroforestry and mono cultural Coffee systems in south western Ethiopia:Biology and fertility of soil 44,653-659.

Muleta Driba,Assefa Fikadu,Nemomissa.S and Gran hall.U (2011). Socio economic benefits of shade Trees: In coffee production systems in Bonga and Yabu hurumu districts, South Western Ethiopia. Farmers perceptions .Ethiopian Journal of educational and sciences 7,39-56.

Muschler.R (2001). Shade improves coffee quality in a sub-optimal coffee –zone of Costa Rica. Agroforestry systems 85,131-139.

Nair.P.K.R (1993). An introduction to agroforestry published by Kluwer academic publishers.

Nair P.K.R.Gordon.A.M and Mosquera -Losada M.R (2008). Agroforestery in Encyclopedia of ecology .Vol(1) Oxford ,Uk.pp101-110.

NMSA (2012). Climate data for Kochere Woreda collected from Fisehagenet Station,2000-2012 National Metrological Service Agency,Addis Ababa.

Perfecto.I,Vander Meer J.H,Bautista G.L Nunez G.I, Green berg R,Bichier .p,Langridge.S (2004). Greater predation in shaded coffee farms: The role of resident neo Tropical birds Ecology 85, 2677-2681.

Perfecto.I,Vander Meer J.H, Mass.A and Soto- pinto L.S (2005).Bio diversity, yield and shade Coffee Certification Ecological Economics 54,435-446.

Sakai.S (2001). Phonological diversity in tropical forests population ecology 43,77-86.Schmitt

Schroth.G (1995). Tree root characterstics as criteria for species selection and systems design:In Agroforestry Systems 30,125-143.

Shimber.T,Kufa Taye and Yilma.A (2002). The effect of established shade trees on the growth and yield of Arabica coffee:In two planting patterns Trieste,Italy. Proceedings of International conference science,May 14th-18th.

Schmitt.C.B,Preisinger HBohmer,H.J (2009). Wild Coffee Management and Plant Diversity in the montaine Rain Forest of South West Ethiopia.

Silva N.T,Tisdell C.A and Bryne P.N (1990). Evaluating techniques for weed control in Coffee; In Papua, New Guinea. International Tree crops journals 6(1), 31-49.

Sluf (2006). Indigenous agroforestry practices and their implications on sustainable land use and natural resources management:the case of Wonago Woredas SIDA and OXFAM Novib,SLUF research report No 1,Addis Ababa Ethiopia.

Soto -pinto.L,villalvazo -Lopez,V.walker,Jimenez -Ferrer.G,Ramirez -Marcial.N,Montoya G and Sinclair F.L (2007). The role of local knowledge in determining shade Composition of multi strata coffee systems:In Chiapas,Mexico .Biodiversity and conservation 16, 419 - 436.

Soto-pinto.L,Perfecto.I,Castillo-Hernandez.J.and Caballero -Nieto. J (2000). Shade effect of coffee production at northern Tzeltal Zone of the state of Chiapas,Mexico .Agriculture Ecosystems and Environment 80,61-69.

Swift.M.J,O.W.Heal and J.M.Anderson (1979). Decomposition in Terristetrial ecosystems Blackwell Scientific Publications ,Oxford,United Kingdom.

Taddesse Kippie (1994). The Gedeo Agro forests and Bio diversity Architecture and floristic.MSc thesis Wageniagen Agriculture University,Wageniagen.

Tadesse Kippie (2002). Five Thousand Years of Sustainability:A case study on Gedeo land use. Southern Ethiopia ,295,Wageningen.

Tadesse Kippie (2002). Gedeo indigenous Agro-forestry; registration campaign gathers Momentum.United Nation Environmental program (UNEP). Highlights Vol.6,No.6.

Gebretsadik Teklu (2016). Assessment of major honey bee flora resources on selected districts of sidama and Gedeo Zones of south nations nationalities and peoples regional state Ethiopia:Journal of Agricultural Economic Extension and rural development 4(2),365-381.

Tesfaye Abrha (2007). Plant diversity in Western Ethiopia Ecology, Ethno botany and conservation: University of Oslo,Norwaye. Presented for degree of doctor of philosophy.

Unruh.JD,Hougton.R,A.Lefebure (1993). Carbon storage agroforestry:An estimate for sub Saharan Africa Climate Restoration (3),39 -52.

Vast,Van Kanten.R,Siles.P,Dzib.B,Franck.N and Harmands J.M (2006). Shade a key Factor for coffee sustainability and quality,887-896.Montpellier Frances.

Yadsa Abebe,Intanna.F and Olsson.M (2001). Contribution of indigenous tree to soil Properties: the case of scattered trees of *Cordia africana* Lam .In crop lands of Western Oromiya, Ethiopia Journal of Natural Resources 3,245-270.

APPENDICES

Appendices 1: Questionnaire

Part i Demographic Back Ground

Thesis title: coffee shade Tree:- Current status,phenology,management practice and threats in Kochore Woreda, Gedeo Zone,SNNP regional state Ethiopia.

Part 1Personal Information

Age 18-30 [ ] 31-40 [ ] 41-60 [ ] above 60 [ ]

Sex Male [ ] Female [ ]

Level of Education Illiterate [ ] Primary [ ] Secondary [ ]

Above secondary []

Languages; Gedeofa ( ) Amharic ( ) Gedeofa and Amharic ( )

Source of income Coffee [ ] Fruit [ ] Enset ventricosum [] Coffee, Enset ventricosum, fruit [ ] other []

Part ii Questions

1) Which native tree species are more preferred as coffee shade tree?
2) What are the criteria used for selecting a tree species as shade tree?
3) Is there a practice of planting other important crop in the coffee farm?
   a) Yes
   b) No
4) If yes which crops?

5) Is there any classification of coffee shade trees as permanent or temporary?
   a) Yes
   b) No

6) If yes. Which tree species are permanent and which tree species are temporary?
7) Are all the coffee shade trees equally represented in your coffee farm land?
    a) Yes
    b) No
8) If your answer for, question no 7 is No which one is more abundant and which one is not?
9) Are there coffee shade trees which are endangered?
10) Coffee shade trees found in your farm land
    a) Matured [ ]
    b) Young or saplings [ ]
    c) Newly planted [ ]
    d) Partly saplings and partly matured trees[]
11) Through which of the following methods are Coffee shade trees propagated?
    a) wildlings [ ]
    b) seedling [ ]
    c) Vegetative means [ ]
    d) Other methods [ ], please specify
12) Do you know the leaf fall, leaf flush, flowering and fruiting periods of these coffee shade trees?
13) Do you have management practices for your coffee shade trees in your coffee farm?
    a) Yes
    b) No
14) If yes, what kind of management do you practice?
15) Apart from shade provision, what are the socio-economic and ecological importance of coffee shade trees? For example do coffee shade trees improve soil fertility {if so, how?}; conserve water (if so how?): used for medicine (if so, how?): used as fodder for animals (if so, which plant part?)
16) Do coffee shade trees present any problem in coffee production system?
17) Problems of sun exposed growing Coffee

    A decrease coffee quality

    B decrease coffee bean size

C growth of coffee plant stunted

D wilting of coffee plant

18) Are there any side effects of growing broad leaf, big and tall coffee shade trees?

19)

20) What are the major threats to coffee shade trees in your localities?

21) Are there any governmental or non-governmental bodies which can take action to stop (minimize) the threats of these coffee shade trees?

a) Yes

b) No

22) If your answer is yes, which action is taken by the concerned bodies?

23) What is your role in protect these coffee shade trees?

24) Have you planted shade trees when you cut or use for any purpose?

25) Do you have the needed skillset for propagating, domesticating and cultivating native coffee shade trees?

26) Is there any coffee shade trees nursery in your area?

ክፍል ፩ ግለ ታሪክ

እድሜ፡ 18-30 ( ) 31-40 ( ) 41-60 ( ) ከ60 በላይ ( )

ፆታ ፡ ወንድ ( ) ሴት ( )

የትምህርት ደረጃ ፡ ያልተማረ ( ) አንደኛ ደረጃ ( ) ሁለተኛ ደረጃ ( ) ከሁለተኛ ደረጃ በላይ ( )

ቋንቋ፡ ጌዲኦፏ ( ) አማርኛ ( ) አማርኛ እና ጌዲኦፉ ( )

የገቢ ምንጭ ፡ ቡና ( ) እንሰት ( ) ፍራፍሬ ቡና፣እንሰት እና ፍራፍሬ ( ) ሌላ ( )

ክፍል ፪ ጥያቄ

1) የትኞቹ አገር በቀል የዛፍ ዝርያ ለቡና ጥላ ዛፍ ያገለግላሉ? ዘርዝሩ

.....

.....

2) የቡና ጥላ ዛፍን ለመምረጥ መመዘኛው ምንድን ነው?

.....

.....

.....

3) ሌሎች ሰብሎችን ከቡና ጋር በቡና ማሳ ውስጥ የመዝራት ወይም የመትከል ልምዱ አለ

ሀ) አዎ ለ) የለም

4) ለጥያቄ ቁጥር 3 መልስዎ አዎ ከሆነ ሰብሎቹን **ዘርዝሩ**

.....

.....

5) የቡና ጥላ ዛፍ ጊዚአዊ እና ቋሚ በመባል ይከፈላሉ?

ሀ) አዎ ለ) አይከፈሉም

6) ከላይ ለተመለከተው ጥያቄ መልሰዎ አዎ ከሆነ የትኞቹ ጊዚያዊ የትኞቹ ቋሚ ናቸው

.....

.....

7) ሁሉም የቡና ጥላ ዛፍ ዝርያዎችበቡና ማሳ ውስጥ በእኩል መጠን ይገኛሉ?

ሀ)አዎ ለ)አይገኙም

8) ከላይ ለተመለከተው ጥያቄ መልሰዎ አይደለም ከሆነ የትኛው የቡና ጥላ ዛፍ በብዛት ይገኛል ፡የትኛው በብዛት አይገኝም.....

.....

9) የመጥፋት አደጋ የተጋረጠባቸው የቡና ጥላ ዛፎች አሉ

.....

10) በማሳዎ ውስጥ የሚገኘው የቡና ጥላ ዛፍ

ሀ) እድሜ ጠገብ ለ) ለጋ ሐ) አዲስ የተተከለ

መ)ግማሹ አዲስ የተተከለ ግማሽ እድሜ ጠገብ

11) የቡና ጥላ ዛፎች በየትኛው መንገድ ይባዛሉ ወይም ይበቅላሉ

ሀ)በጫካ ለ) ዘር በመዝራት ሐ) ችግኝ በመትከል

12) የቡና ጥላ ዛፍ እያንዳንዳቸው ቅጠል የሚራግፉበትን፣ቅጠልየሚያበቅሉበትን፣አበባ የሚያብቡበትን እና ፍሬ የሚያፈሩበትን ወቅት ይግለጡ.....

.....

.....

13) በቡና ማሳ ውስጥ የሚገኙትን የቡና ጥላ ዛፍ ለቡና ጥላ ተሰማሚ እንዲሆኑ ለማድረግ የተለያዩ ሰራዎችን ይሰራሉ ? .

ሀ) አዎ ለ) አልሰራም

14) ከላይ ለተመለከተው ጥያቄ መልሰዎ አዎ ከሆነ ምን ምን ሰራ ?.....

15) ከቡና ጥላነት በተጨማሪ ማህበራዊ፣ኢኮኖሚያዊእና አካባቢያዊ ጥቅም አላቸው ለምሳሌ የአፈርጥበቃ

እንዴት?..... .....

ለመድሀኒት እንዴት?.....

ለእንሰሳት ምግብ እንዴት?.....

ለንብ ምግብ እንዴት?.....

16)የቡና ጥላ ዛፎች ቡናን በማምረት ሂደት ውስጥ ያላቸውየጎንዮሽ ችግር ምንድን ነው?.....

.....

17) የቡና ማሳ ለጸሀይ ቢጋለጥ ወይም የቡና ጥላ ዛፍ ባይኖር ከሚከተሉት የትኛው ችግር ይከሰታል

ሀ) የቡናው የጥራት ደረጃ ይቀንሳል

ለ) የቡናው ፍሬ መጠን ደቃቅ ይሆናል

ሐ)የቡና ምርት ይቀንሳል

መ) የቡና ተክል እድገት ቀጫጫ መሆን

ሠ) የቡናው ተክል መጠውለግ

18) ቅጠለ ሰፋፊ፣ትልልቅ እና ረጣዥም ዛፎችን ለቡና ጥላ መጠቀም የሚያመጡትችግር ምንድን ነው?.....

.....

.....

19) በአካባቢያችሁ የቡና ጥላ ዛፍ የመጥፋት ወይም የመቀነስ ሰጋት አለ?

ሀ)አዎ ለ) የለም

20) ከላይ ለተመለከተው ጥያቄመልሰዎ አዎ ከሆነ ምክኒያቱምንድን ነው?……..

21) የሚመለከተው የመንግሰት አካል እና መንግሰታዊ ያልሆነ ድርጅት የቡና ጥላ ዛፍ የመጥፋት አደጋ ለመቀነሥ የሠሩት ሥራ አለ?

ሀ) አዎ ለ) የለም

22) ከላይ ለተመለከተው ጥያቄ መልሰዎትአዎ ከሆነ ምንአይነትስራ ተሰርቷል?.....

23) የቡና ጥላ ዛፎችን ከመጥፋት አደጋ የመጠበቅ የእርሰዎ ድርሻ ምንድን ነው?.....

24)ለየትኛውም አገልግሎት የቡና ጥላ ዛፎችን ሲቆርጡ በምትኩ ሌላ ዛፍ ይተክላሉ?.....

25)የቡና ጥላ ዛፎችን የማባዛት፣የማላመድ እና የማብቀል ችሎታ አለዎት?.....

26) የቡና ጥላ ዛፍ ችግኝ ጣቢያ አለ?

Appendices 2: Representative of the selected common tree species