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Coffee growers' local knowledge on shade tree species in Adola Rede District, Guji Zone, Southern Ethiopia

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Farmers have a detailed local knowledge about different tree species which are either retained or planted on their farms. Thus, it is possible to learn from farmers' observations to enhance understanding of local agro-ecological knowledge. This study aimed to investigate coffee growers' local knowledge on shade tree species. The study was conducted at Adola Rede District, in Guji Zone, Southern Ethiopia. To address the objectives of this study, necessary data were collected through key informant interview and questionnaire survey. A total of 30 key informants and 90 households participated in the household interview. The study results revealed that coffee growers preferred shade grown coffee plants for better coffee yields, to protect coffee plants from unsuitable environmental stress, for soil fertility improvement and for longer life span of coffee plants. Coffee growers also encountered wilting and stunted growth of coffee plants, coffee yield reduction, poor soil fertility, less coffee stems and branches, besides coffee plants need more management when grown open. In the study district, eleven commonly used coffee shade tree species were identified. Based on their criteria of suitability identification, coffee growers preferred compatible shade tree species such as *Ficus sur, Millettia ferruginea, Cordia africana, Albizia gummifera, Croton macrostachyus* and *Vernonia amygdalina,* in this order. In the study area, the scale of shade tree species preferences for coffee growers varies. However, their main preferences of shade tree characteristics were mainly based on shade tree height, crown shape and evergreen or deciduous quality of the shade tree species. Coffee growers of the study area managed their owned shade tree species through pruning, thinning, pollarding and coppicing tending operations. They practiced various shade tree managements such as to cud dead or over grown branches, to collect wood used for various uses and to reduce of the shade for coffee plants. Therefore, based on the finding of this study, if the knowledge of local farmers is recorded and effectively used with scientific findings, it can provide valuable information that can give feedback synergistically to channel the direction of conventional science to meet the needs of local people.

Key words: Adola Rede District, coffee growers, local knowledge, coffee shade tree species.

INTRODUCTION

Ethiopia is the home and cradle of biodiversity of Arabica coffee seeds and more genetically diverse strains of *Coffee arabica* exist in Ethiopia than anywhere else in the world (Bayetta, 2001). Moreover, Ethiopia is the largest

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producer of coffee in sub-Saharan Africa, fifth largest coffee producer in the world, contributing about 7 to 10% of total world coffee production (Abu and Tedy, 2013). Coffee has economical, environmental as well as social significance to the country and 25% of the total population of the country depends on coffee production (MARD, 2008; FAO, 2012).

Coffee is the most important source of foreign currency for many developing countries and 70% of the world coffee is contributed by smallholder farmers who grow coffee mostly on farms of less than 5 ha (Mohan and Love, 2004). In Ethiopia, estimated numbers of coffee growers are 1.3 million and coffee is growing on 662,000 ha, of which 496,000 ha are estimated to be productive, yielding an average of 350,000 tons of coffee beans per annum (Agrisystems, 2001; Muleta et al., 2007).

The major coffee production systems of Ethiopia include: forest coffee, semi-forest coffee, garden coffee and plantation coffee, which respectively cover 5, 35, 50 and 10% of the productive coffee area (Aga et al., 2003; Mekuria et al., 2004). The forest ecosystem of Ethiopia includes forest and semi-forest coffee production that occupies nearly 33% of land used for coffee production and contributes 25% of the national coffee production (Taye, 2009). Accordingly, Ethiopian coffee plants grow understory of evergreen natural forest and under managed agroforestry systems above 500,000 ha (Aga et al., 2003).

Based on their acquired inherited local knowledge, coffee growers had been cultivating coffee plants as an important cash crop under the canopy of shade tree species (Gole, 2003). They have detailed local knowledge about different tree species growing in their farm lands. They recognize physical, biological and phonological attributes and interactions between tree species cover and components of the farm; and this is as a result of their experience, acquired and inherited local knowledge (Munoz et al., 2001). That is, the longer time farmers had worked with trees on their farms or in the landscape, the more detailed local knowledge they accumulated through experimentation and experience (Ruth, 2010).

Their local knowledge is a part and parcel of communities' identity that is unique to a culture and society. It is embedded in the communities' practices, institutions, relationships, customs, ethical principles, religious beliefs and rituals (WWF, 2013). Local knowledge provides a powerful basis from which alternative ways of managing resources can be developed. Rural communities in a number of developing countries use their traditional knowledge to generate income, food and health care materials, like traditional medicine. Therefore, local knowledge systems also serve as a reference when designing any management plan (Twarog and Kapoor, 2004).

The study result of Close and Hall (2005), carried in Turkey indicated that, despite heavy reliance on scientific knowledge as the primary source of information in resource management, many resources are in decline. To combat this trend, researchers have been drowning upon the knowledge of local resource users as an important supplement to scientific knowledge in designing and implementing management strategies. Therefore, to establish research priorities on promising coffee shade tree species in the study district, study of coffee growers' local knowledge is fundamental as they have considerable knowledge about coffee shade tree species which has not been documented and utilized. In this regard, recording coffee growers' local knowledge is vital to design systematic plan for sustainable coffee production in the study district through combining their inherited local knowledge with scientific findings. Therefore, this study was conducted (i) to identify coffee growers' local knowledge on management of coffee shade tree species, (ii) to identify coffee growers' local knowledge on suitability identification of shade trees for coffee plants, and (iii) to identify coffee growers' local knowledge on benefits of shade trees for coffee plants.

MATERIALS AND METHODS

Description of the study area

Location

Adola Rede district is located in Guji zone, Oromia Regional State, in Southern part of Ethiopia. The absolute location of the district is between 5°44'10" - 6°12'38" North latitude and 38°45'10" - 39°12'37" East longitude (Figure 1). The total area of Adola Rede district is 1401 km^2 and it is located at 475 km south of Addis Ababa (Yazachew and Kasahun, 2011).

Soil and topography

The major soil of Adola Rede district is nitosols (red basaltic soils) and orthcacrosols. The soil of the study district is dominantly brown. The forest area is characterized by a rolling topography and it is highly dissected by two main rivers of Genale and Dawa. Moreover, it has an elevation ranging from 1500 m above sea level in the southern part of the district. Whereas, in the north-western part of the district, it has an elevation greater than 2000 m above sea level (Yazachew and Kasahun, 2011).

Climate

Adola Rede district is characterized by three agro-climatic zones. The percentage of coverage of each agro-climatic zone of the district is high land 33%, mid-land 47% and low lands 20% (Yazachew and Kasahun, 2011). According to the climatic data from meteorological station of Adola Rede district, the mean annual maximum and minimum temperature of the study district is 23 and 16°C, respectively. The study district has bimodal rainy seasons, summer from June to November and spring from March to May.

Vegetation

Adola Rede district is enriched with both high natural forest resources and plantation forests. The natural vegetation of the Adola Rede district is over 50,000 ha. In the study district, Wadera,

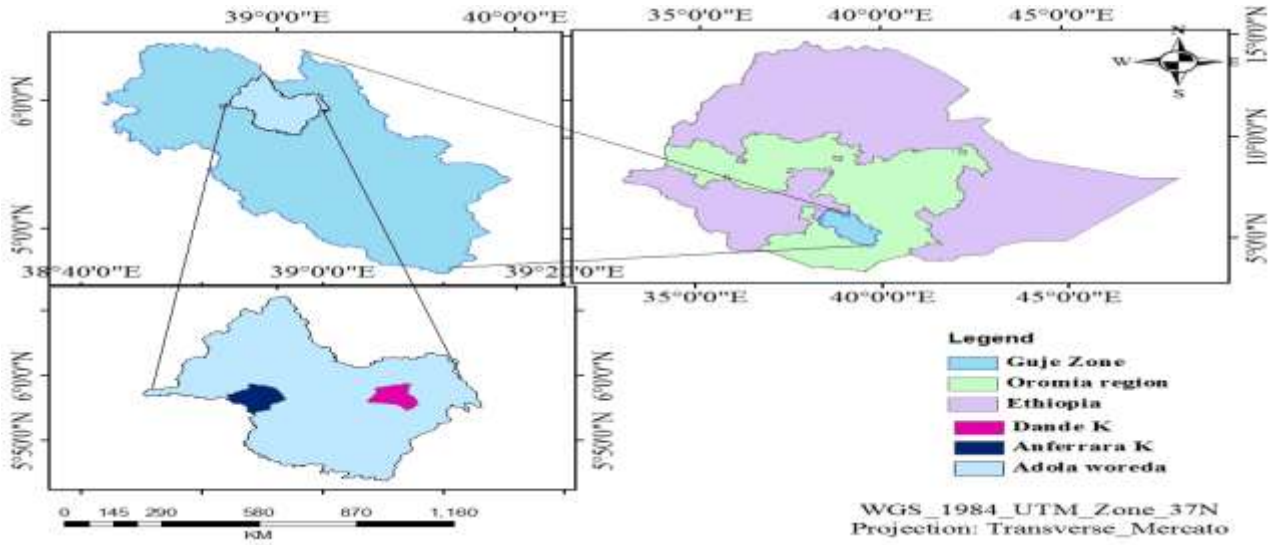

Figure 1. A map showing the study site.

Zenbaba and Anferara forests are identified as the dominant forest coverage of the study district (Yazachew and Kasahun, 2011).

Socioeconomic characteristics

The total population of Adola Rede district is 583,816. From the total area of Adola Rede district, 33% is cultivation land, 30% is pasture land, 20% is forest land, and 17% is swampy or degraded land (CSA, 2008). The livelihood of majority of the inhabitants in the study area is mixed farming, coffee production and semi-nomadic economic activities (CSA, 2008).

Data collection methods

The various data collection tools employed were key informant interview to collect mainly qualitative information. The household survey was used to collect mainly detailed quantitative data about coffee growers' local knowledge on benefits, suitability identification and management of coffee shade tree species from the sampled households.

Selection of sample households

In this study, a household is defined as a basic unit of production and consumption, made up of the persons who have common fields and live under one central decision-maker. There are several approaches used to determine the sample size of households. These include using a census for small populations, imitating a sample size of similar studies, using published tables and applying formulas to calculate a sample size (Israel, 2012). This study applied the simplified formula developed by Yamane (1967) and reviewed by Israel (2012).

$$n = \frac{N}{1 + N(e)^2}$$

where 'n' is the sample size, 'N' is the population size and 'e' is the level of precision.

For this study, to determine the required sample size at 90% confidence interval, a ±10% precision level was used and a total of 90 respondents were randomly selected for the questionnaire interview from the two study kebeles.

Site selection for the study

Primarily, the study district was selected purposively based on the availability of coffee shade tree species and based on probability of coffee production. There are 10 kebeles in the study district known for major shaded coffee production and two were randomly selected for the study.

Selection of key informants

Key informants in this study are persons who are knowledgeable about coffee shade trees, experienced in growing coffee plants under storey of different shade trees and who have always lived in the village and for a long time. The selection of key informants was done using the snowball method. During key informants' selection, in each village at least five farmers were asked to identify and give names of six key informants. Then the identified key informants were ranked and the most frequently appeared top five persons were assigned as key informants. Finally, a total of 30 key informants were selected and used for the study.

Data analysis

The collected data from the questionnaires of household interview responses were coded and entered into Microsoft Office Excel sheet. Data were grouped and summed by response category on the data sheet. After organizing the data on Microsoft Office Excel, the analysis was performed using Statistical Package for Social Science version 20 for windows (IBM SPSS Inc, USA) software. Descriptive statistics was used to show farmers' local knowledge on benefits of shade trees for coffee plants, farmers' local knowledge on suitability identification of shade trees for coffee plants, and

farmers' local knowledge on management of coffee shade trees either retained or planted on their landscape.

RESULTS AND DISCUSSION

Coffee growers' local knowledge on management of coffee shade tree species

Coffee growers' source of shade tree planting material

In addition to naturally grown shade tree species, planting of different shade tree species is widely practiced in the study district. Coffee growers' in the study site mentioned several source of shade tree planting material. Of all the respondents, 34.44 and 17.77% of the respondents use self established planting material and from neighbor farmers, respectively. For about 27.7 and 20% of the respondents, source of shade tree planting materials were from natural forest of the area and government nursery respectively (Table 5). Both key informants and sampled households confirmed that, farmers' have the trend of collecting naturally regenerated shade tree species from natural forest and transplanted on their coffee farms. Commonly, they collect seedling of *Cordia africana, Millettia ferruginea, Ficus sur, Croton macrostachyus* and *Albizia gummifera* shade tree species from natural forest and transplant to their coffee farms.

Tending of shade tree for coffee plants

Coffee growers' at the study site have good experience on management of shade tree species through different tending operations. However, the scale of shade tree species managements of coffee growers' of the study district varies. For example, about 83% of the respondents have their own experience on tending of shade tree for coffee plants that consider thinning, pruning, pollarding and coppicing tending operations. However, the remaining 7% of the respondent households did not apply different tending operations for their owned shade tree species.

At the study district, 21.6% of the respondents use thinning operation for densely grown naturally regenerated shade tree species. It is well recognized that shade trees in the natural forest are characterized by high density, closed canopy cover and cast heavy shade on coffee plants. To reduce heavy shade cover on coffee plants, to minimize competition between shade tree and coffee plants and to create good conducive environment for coffee plants, farmers employed thinning operation (Table 6). Consistent with this study findings is Mesele (2007) who indicated in his study that farmers' in Gedio zone, Southern Ethiopia practiced thinning operation, when crowns of different more adjacent tree species started to close and create heavy shade on under storey crops. Moreover, Regina et al. (2012), on their study finding indicated that, in southern Bahia, Brazil, to minimize negative effect of shade tree species on understory cacao trees, cacao growers' deliberately reduced densely grown over storey of cacao trees through thinning management practice.

In the study site, majority (50.7%) of the respondents apply pruning of shade trees when their canopy cover closed and cast heavy shade on coffee plants and collect wood used for various purposes. Moreover, when they need shade trees for timber production, they usually practice pruning to reduce shade tree branches for a better growth (Table 6). The finding of this study is supported with previous findings of Motuma (2006) and Getahun et al. (2014). According to their study findings, farmers' in Arsi Negelle district, East Arsi zone and Ginbo district, South West Ethiopia practiced pruning of indigenous woody species and coffee shade trees to reduce the effect of shade on understory crops, to get other additional benefits and to improve production of under storey crops. About 15.7 and 12% of the respondents employed coppicing and pollarding operation for their owned different shade tree species, respectively (Table 6). According to the respondents, they are employing coppicing operation during harvesting time of shade trees for various purposes for instance for timber and construction value. In the study site, farmers commonly use pollarding at summer time to reduce effect of shade on understory crops mainly growing with shade trees. This idea is also supported by key informants.

Coffee growers' local knowledge on suitability identification of shade tree species

Coffee growers' selection criteria of compatible shade trees with coffee plants

In the study district, 11 shade tree species commonly used to shade coffee plants were identified. However, the frequency occurrence of shade tree species were quite different among respondents coffee farms/fields and some shade tree species were more frequently retained than others (Figure 2). Among shade tree species commonly used to shade coffee plants in the study district, *M. ferruginea, C. africana* and *C. macrostachyus* were the top ranking three shade tree species recorded on coffee farms/fields of 75% of the respondents (Figure 2).

As shown in Table 3, at the study site, coffee growers' select compatible shade tree species with coffee plants using different criteria. Accordingly, about 37.8% of the respondents use better coffee yields under a shade tree as a criteria and 24.4% of the respondents use fast growing ability of coffee plants under a shade tree as a selection criteria. Moreover, about 19% of the respondents use fast decomposition rate of shade tree

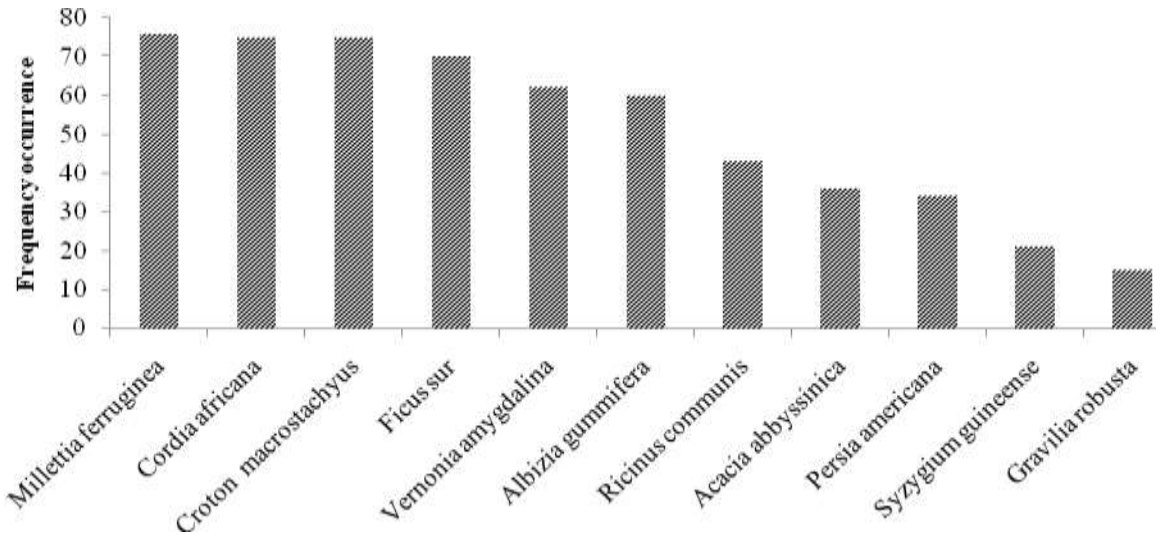

Figure 2. Frequency of the shade tree species commonly used for shading coffee plants in farmers' fields of the study district.

litter fall and the other 19% of the respondents use fast growing ability of a shade trees as a selection criteria. This is in agreement with opinion of key informants.

Therefore, farmers at the study site have profound knowledge on preferences of compatible shade tree species with coffee plants. From commonly used shade tree species in the study district, *F. sur*, *M. ferruginea*, *C. africana*, *A. gummifera*, *C. macrostachyus* and *Vernonia amygdalina* were among listed preferred compatible shade tree species with coffee plants. The finding of this study is relatively similar with the study result of Ashenafi et al. (2014). Their study findings indicated that, in South Ethiopia, farmers preferred compatible shade tree species such as *M. ferruginea, C. africana, E. abyssinica, F. sur* and *G. robustar*, respectively. Contrary, the finding of this study is different from Ashenafi et al. (2014) on farmers' selection criteria of compatible shade tree species, except similarity on fast growing ability of shade tree species. From their observation, Ashenafi et al. (2014) indicated that coffee growing farmers' means of compatible shade tree species selection criteria was based on fast growth rate of shade tree, less competitiveness of shade tree with coffee plants, good light interception and adaptive nature of shade tree species.

Coffee growers' preferences of coffee shade tree species characteristics

At the study site, the scale of shade tree species preferences of respondents varied. For example, about 89% of the respondents have their own preferences of shade tree characteristics that consider shade tree height, crown shape, evergreen or deciduous quality of the shade tree species.

In terms of height, majority (71.3%) of the respondents prefer longer shade tree species on their coffee farms (Table 4). Longer shade trees are preferred for timber production and construction value, since they provide adequate sun light to coffee plants and for bee keeping. Similar to this study finding, Albertin and Nair (2004) and Soto-Pinto et al. (2007), on their study findings indicated that coffee farmers' at the northern Tzeltal zone of the state of Chiapas, Mexico and in Nicoya Peninsula, Costa Rica, prefer longer shade tree species on their coffee farms. However, their findings did not indicate the reason for coffee growing farmers' prefer longer shade tree.

On the other hand, about 16.2% of the respondents prefer shorter shade tree species. Shorter shade trees are suitable for different management and damage to coffee plants from different tending operation is less. The finding of this study is supported with a study of Albertin and Nair (2004) and Samuel (2012). On their study, findings showed that, in Nicoya Peninsula, Costa Rica and in Ghana, Ejisu-Juaben district, farmers' main reason for preferences of shorter shade trees consisted of droplets from shorter shade trees which causes less erosion than taller shade trees and management is easier for shorter shade tree. Whereas, 12.5% of the respondents prefer combination of both shorter and longer shade tree species (Table 4). They indicated that, when longer mature shade trees are harvested to give various uses, the remaining shorter shade tree species provide shade for coffee plants.

In terms of coffee shade trees crown shape, majority (78.8%) of the respondents believe that spreading crown coffee shade trees are more suitable than narrow crown shade tree. The main reasons of their preferences include when shade trees are sparsely retained on their

Table 1. Respondent households (n=90) and their opinion on the benefits of shade trees for under canopy coffee plants.

Benefits of shade trees to coffee plants	Study kebeles and number of respondents			
	Anferara	Dande	Frequency (f)	Percentage
Protect coffee plants from adverse environmental stress	11	18	29	32.2
Soil fertility status under coffee plants improved	11	8	19	21.1
Better coffee yields	13	9	22	24.4
Longer life span of coffee plants	9	11	20	22.3

Source: From Survey Result (2014/2015).

coffee farms, spreading crown provides adequate shade to coffee plants and is easier to manage as well as suitable for bee keeping (Table 4). The finding of this study is strengthened with studies of Albertin (2002) and Albertin and Nair (2004). They indicated in their study, coffee growers in Peninsula of Nicoya, Costa Rica prefer spreading crown shade trees since they provide better shade to coffee plants and for good management practice of the shade tree. On the other hand, about 21.2% of the respondents prefer shade tree species with narrow crown, since they need to have more diverse shade tree species on their small size of coffee farms.

As shown in Table 4, 50% of the respondents' preferred evergreen shade tree species on their coffee farms. Evergreen shade trees are preferred to provide animal fodder during long dry season and crucial to protect coffee plants from extreme sun light throughout the year. In line with this finding, Albertin and Nair (2004), Diriba et al. (2011) and Samuel (2012) on their study results indicated that, farmers in Costa Rica, South Western Ethiopia, and in Ghana, Ejisu-Juaben district, respectively preferred evergreen shade trees above deciduous ones because the shade is obligatory for coffee plants in the dry season.

Of all the respondents, 23.8% of households preferred deciduous shade tree species mainly for nutrient cycling through litter fall. Consistent with this study, Beer (1987) and Ashenafi et al. (2014) on their study findings indicated that coffee farmers only consider deciduous quality of shade tree species and do not consider evergreen nature of the shade trees to be a critical preference. In general, about 26.2% of the respondents preferred both deciduous and evergreen shade tree species (Table 4). According to both key informants and sampled households, during deciduous shade tree species shedding their litter fall, the remaining evergreen shade tree species could protect coffee plants from inappropriate environmental stress.

Coffee growers' local knowledge on benefits of shade trees for coffee plants

At study district the benefits of coffee shade trees are well recognized by respondents. As a result, all the respondents considered shade trees as a prerequisite for coffee production. About 32.2% of the respondents suggested that shade trees are so important to protect coffee plants from adverse environmental stress such as extreme sun light, frost, hail and surplus wind speed (Table 1). According to respondents, shade trees are vital to protect the new planted coffee seedlings from undesirable environmental stress that make them wilted and growth stunted. Moreover, shade trees protect coffee plants from adverse climate conditions during their flowering and fruiting stage. This idea is also supported by key informants. The finding of this study is strengthened with previous studies of Albertin and Nair (2004), Claudia (2010), Santos et al. (2012) and Adugna and Paul (2014). Their study findings note that, shade trees improve the climate for coffee plants by buffering temperature extremes in the air and soil and by reducing wind velocity in coffee plantations.

As shown in Table 1, benefits of shade tree include better coffee yields (24.4% HHs) and enhancing soil fertility under their canopy by 21.1% of the respondents. According to both key informants and respondent households, better coffee yields obtained from shade grown coffee plants due to leaf litter and pruning of shade tree decomposing and maintain soil fertility under coffee plants. Moreover, shade grown coffee plants are protected from adverse environmental stress. As a result, coffee plants grow healthy, flower in time and produce better coffee yields. Similar to this study finding, Soto-Pinto (2000), Diriba et al. (2011), Robert (2011) and Ashenafi et al. (2014) found out that shade trees have a positive effect on coffee plants and better coffee yields are obtained from under shade grown coffee plants than that grown under full sun. However, contrary to this study finding, Adugna et al. (2014) showed that beans developed under shaded condition were heavier, larger in size and had better liquor taste. However, greater coffee yields are obtained from sun grown coffee plants. Haggar et al. (2011) also indicated that shade trees compete with coffee for resources and in a very wet year, shade can promote the growth of moisture-loving fungi, which may reduce the yield of shade-grown coffee plants.

Based on the findings of this study, about 22.3% of the respondents indicated that, shade grown coffee plants have longer life span than that grown under full sun.

Table 2. Respondents households (n=90) and their opinion on problem of growing coffee plants without shade tree species.

Problem of open grown coffee plants	Study kebeles and Number of respondents			
	Anferara	Dande	Frequency (f)	Percentage
Wilting and stunted growth of coffee plants	14	10	24	26.7
Poor soil fertility under coffee plants	11	9	20	22.2
Reduction of coffee yield	10	9	19	21.1
Less coffee stems and branches	6	8	14	15.6
Coffee plants need more managements	9	4	13	14.4

Source: From Survey Result (2014/2015).

Table 3. The sampled households response (n=90) on selection criteria of compatible coffee shade tree species.

Farmers' criteria to select compatible shade tree spoecies	Study kebeles and Number of respondents			
	Anferara	Dande	Frequency(f)	Percentage
Better coffee yield under a shade tree	21	13	34	37.8
Enabling fast growth of a coffee plants under a shade	13	9	22	24.4
Fast growing ability of a shade tree	11	6	17	19
Decomposition rate of shade tree litter fall	8	9	17	19

Source: From Survey Result (2014/2015).

Shade tree protected coffee plants from extreme sun light, from other unsuitable environmental stress and regulates climatic conditions for coffee plants. Open grown coffee plants often suffer a premature death and they need to be replaced much more frequently than shade grown coffee plants. This study finding is in agreement with the observations of Denis (2003), Albertin and Nair (2004), Damatta (2004) and Claudia (2010). From their study findings, shade grown coffee plants have a longer life expectancy than sun grown coffee plants and shade trees have a benefit to reduce coffee plants exhaustion. Moreover, by modifying microclimatic conditions, shade trees stabilize the yields throughout the seasons, making planning and harvesting more efficient for the farmer and prolong the life span of coffee plants.

Based on their accumulated experience and inherited local knowledge, coffee growers in the study district easily recognized problems associated with sun grown coffee plants. Accordingly, 26.7% of the respondents indicated that wilting and stunted growth of coffee plants are a serious problem of open grown coffee plants (Table 2). Moreover, about 21.1 and 22.2% of the respondents reported low coffee yield and poor soil fertility under coffee plants are a major problem (Table 2). Open grown coffee plants are characterized by 15.6% of the respondents as having less number of coffee stems and branches and 14.4% of the respondents confirmed that sun grown coffee plants need more managements as compared to shade grown coffee plants (Table 2). Both key informants and sampled households indicated that, sun grown coffee plants exposed to adverse environmental stress and soil fertility under coffee plants are poor. In addition, sun grown coffee plants easily get damaged with domestic and wild animals; due to this coffee plants could be demanding more management and having less number of coffee stems and branches.

Conclusion

Coffee growers in the study district have been cultivating coffee plants under the shade of natural forest canopy and under plantation shade tree covers for a long time. They enhanced the trend of growing shaded coffee plants through their inherited knowledge and experiences acquired from various sources. Overall, farmers showed a good understanding on the benefits of shade tree for coffee plants. Shade tree reduces undesirable environmental stress on coffee plants by ameliorating adverse climatic conditions. Moreover, yield of shade grown coffee plants increased due to soil fertility enhancements and shade grown coffee plants have longer life span than that grown under full sun. Coffee growers' also encountered wilting and stunted growth of coffee plants which have negative impact on coffee yields when grown open. Moreover, open grown coffee plants have less coffee stems and branches and more management is required for coffee plants.

Coffee growers have profound knowledge about management practice of various shade tree species they owned. The trends of planting different coffee shade trees are commonly known in the study site and farmers have various source of planting material. Their source of shade tree planting material is self-established, from

Table 4. Respondent households (n=80) and their opinion on preferences of shade tree height, crown shape and evergreen or deciduous characteristics of shade tree species.

Shade tree characteristics	Farmers' preference	Study kebeles and Number of respondents			
		Anferara	Dande	Frequency (f)	Percentage
Tree height	Longer shade tree	29	28	57	71.3
	Shorter shade tree	6	7	13	16.2
	Combination of both	7	3	10	12.5
Crown shape	Spreading crown	34	29	63	78.8
	Narrow crown	8	9	17	21.2
Evergreen or deciduous	Evergreen	14	26	40	50
	Deciduous	13	6	19	23.8
	Combination of both	18	3	21	26.2

Source: From Survey Result (2014/2015).

Table 5. The sampled households response (n=90) on source of coffee shade tree planting material.

Farmers' source of shade tree planting material	Number of respondents and Study kebeles			Percentage
	Anferara	Dande	Frequency (f)	
Self-established	20	11	31	34.44
From natural forest	13	12	25	27.77
From government nursery	11	7	18	20
From neighbor farmers	8	8	16	17.77

Source: From Survey Result (2014/2015).

Table 6. Different shade tree management practices undertaken by the coffee growers' at Adola Rede District.

Commonly used tending operation	Study kebeles and Number of respondents			
	Anferara	Dande	Frequency (f)	Percentage
Thinning	10	8	18	21.6
Pruning	25	17	42	50.7
Coppicing	7	6	13	15.7
Pollarding	2	8	10	12

Source: From Survey Result (2014/2015).

neighbor farmers, government nursery and natural forest. Coffee growers' in the study site regularly manage their owned coffee shade trees through employing thinning, pruning, coppicing and pollarding tending operation. Farmers commonly practiced various tending operation for their owned shade tree species; to cud dead or over grown branches, to collect wood used for various purposes and to reduce the shade of coffee plants and for a better production of understory crops.

Coffee growing farmers have an extensive knowledge on preferences of coffee shade tree characteristics. However, the scale of shade tree preferences of farmers was variable and mainly considers shade tree height, crown shape, evergreen or deciduous characteristicsof shade tree species. Therefore, based on the finding of this study if knowledge of local farmers is recorded and effectively used with scientific findings, it can provide valuable information that can give feedback synergistically to channel the direction of conventional science to meet the needs of local people.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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